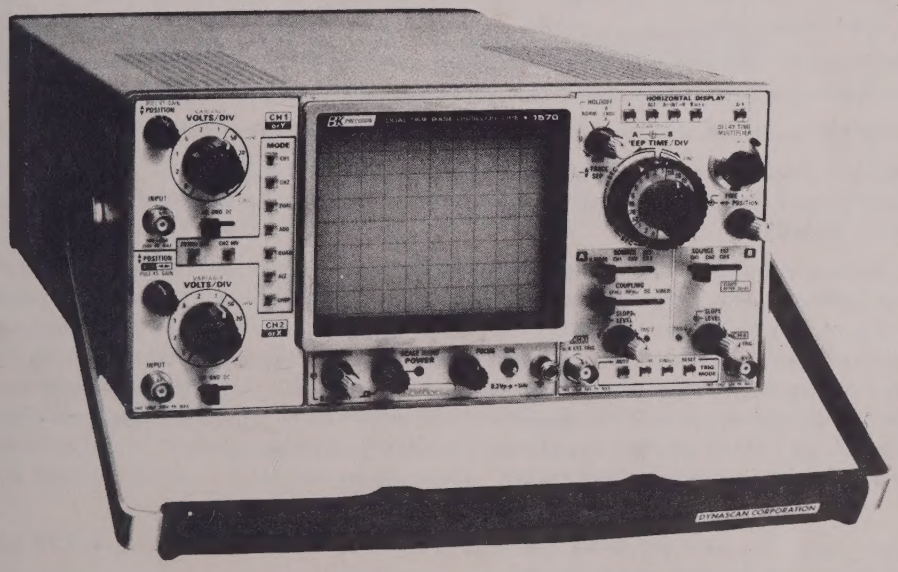
INSTRUCTION MANUAL

B+K PRECISION 1570

70MHz

Quad-Trace Oscilloscope



B+K PRECISION DYNASCAN CORPORATION

TEST INSTRUMENT SAFETY

WARNING

Normal use of test equipment exposes you to a certain amount of danger from electrical shock because testing must often be performed where exposed high voltage is present. An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Voltage as low as 35 volts dc or ac rms should be considered dangerous and hazardous since it can produce a lethal current under certain conditions. Higher voltages pose an even greater threat because such voltage can more easily produce a lethal current. Your normal work habits should include all accepted practices that will prevent contact with exposed high voltage, and that will steer current away from your heart in case of accidental contact with a high voltage. You will significantly reduce the risk factor if you know and observe the following safety precautions:

1. Don't expose high voltage needlessly. Remove housings and covers only when necessary. Turn off equipment while making test connections in high-voltage circuits. Discharge high-voltage capacitors after removing power.
2. If possible, familiarize yourself with the equipment being tested and the location of its high voltage points. However, remember that high voltage may appear at unexpected points in defective equipment.
3. Use an insulated floor material or a large, insulated floor mat to stand on, and an insulated work surface on which to place equipment; and make certain such surfaces are not damp or wet. Where insulated floor surface is not available, wear heavy gloves.
4. Use the time-proven "one hand in the pocket" technique while handling an instrument probe. Be particularly careful to avoid contacting a nearby metal object that could provide a good ground return path.
5. When using a probe, touch only the insulated portion. Never touch the exposed tip portion.
6. When testing ac powered equipment, remember that ac line voltage is usually present on some power input circuits such as on-off switch, fuses, power transformer, etc. any time the equipment is connected to an ac outlet, even if the equipment is turned off.
7. Some equipment with a two-wire ac power cord is transformerless "hot chassis" powered, where one side of the ac power line connects directly to the chassis. If such equipment does not have a polarized plug to prevent insertion the "wrong" way, a serious shock hazard exists if the chassis is touched. Not only does this present a dangerous shock hazard, but damage to test instruments or the equipment under test may result from connecting the ground lead of most test instruments (including this oscilloscope) to a "hot chassis". To make measurements in "hot chassis" equipment, always connect an isolation transformer between the ac outlet and the equipment under test. The **B & K-Precision** Model TR-110 Isolation Transformer is suitable for most applications. To be on the safe side, treat all two-wire ac powered equipment as "hot chassis" unless you are sure it has an isolated chassis or an earth ground chassis.
8. Never work alone. Someone should be nearby to render aid if necessary. Training in CPR (cardio-pulmonary resuscitation) first aid is highly recommended.

Instruction Manual
for

B+K PRECISION

Model 1570

70 MHz

Quad-Trace Oscilloscope

B+K PRECISION DYNASCAN CORPORATION

6460 West Cortland Street
Chicago, Illinois 60635

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SPECIFICATIONS

CRT

Model:	150CTM31
Display area:	8 × 10 div (1 div = 1 cm)
Type:	Rectangular, with internal graticule
Accelerating potential:	12 kV

VERTICAL AXIS (Channel 1 and Channel 2 identical specifications)

Sensitivity:	5 mV/div to 5V/div (X1 mode) 1 mV/div to 1V/div (X5 mode) 500 μV/div (Cascaded operation, CH1 to CH2)
Accuracy:	±3% (10 ~ 35°C) ±5% (0 ~ 50°C) ±8% (Cascaded operation, CH1 to CH2)
Attenuator:	5 mV/div to 5V/div in 1-2-5 sequence, all 10 ranges with fine adjustment.
Input resistance:	1 MΩ ±2%
Input capacitance:	Approx. 28 pF
Frequency response:	(Include × 5 GAIN mode)
DC:	DC to 70 MHz (−3 dB) DC to 80 MHz (−6 dB) DC to 40 MHz (−3 dB) (Cascaded operation, CH1 to CH2)
AC:	5 Hz to 70 MHz (−3 dB) 5 Hz to 80 MHz (−6 dB) 7 Hz to 40 MHz (−3 dB) (Cascaded operation, CH1, to CH2)
Risetime:	5ns
Signal delay time:	Approx 20ns as displayed on CRT screen
Crosstalk:	−40 dB minimum
Operating modes:	
CH1	CH1, single trace
CH2	CH2, single trace
DUAL	CH1 and CH2, dual trace
ADD	CH1 + CH2 (added) display
QUAD	CH1 ~ CH4, four trace
ALT	Two or four waveforms, alternating
CHOP	Two or four waveforms, chopped
CHOP frequency:	Approx 250 kHz
Polarity reversal:	CH2 only
Maximum input voltage:	500 Vp-p or 250V (DC + AC peak)
Maximum undistorted amplitude:	8 division, minimum (DC to 70 MHz)
Bandwidth limiting:	Vertical system bandwidth is approximately 20 MHz with the 20 MHz BW pushbutton switch pushed.

VERTICAL AXIS (Channel 3 and Channel 4 common specifications)

Sensitivity:	0.1V/div. ±3%
Input resistance:	1 MΩ ±2%
Input capacitance:	Approx. 28 pF
Input coupling mode:	DC only
Frequency response:	DC to 70 MHz (−3 dB) DC to 80 MHz (−6 dB)
Risetime:	5 ns
Signal delay time:	Same as CH1 and CH2
Maximum input displayed:	
DC component:	±0.5V or less (AC + DC)
AC component:	1 Vp-p or less
Maximum input voltage:	50V (DC + AC peak)

HORIZONTAL AXIS (CH2 input)

Modes:	X-Y mode is switch selectable (HORIZONTAL DISPLAY)
X-Y mode:	CH1: Y-axis CH2: X-axis
Sensitivity:	Same as CH2
Accuracy:	Same as CH2
Input resistance:	Same as CH2
Input capacitance:	Same as CH2
Frequency response:	
DC:	DC to 5 MHz (−3 dB) DC to 6 MHz (−6 dB)
AC:	5 Hz to 5 MHz (−3 dB) 5 Hz to 6 MHz (−6 dB)
X-Y phase difference:	Less than 3° at 100 kHz

SWEEP

Modes (switchable with the HORIZONTAL DISPLAY switch):

A	A Sweep
ALT	A Sweep (intensified for duration of B Sweep) and B Sweep alternating.
A-INT-B	Duration of the B Sweep is displayed as an intensified portion of the A Sweep.
B DLY'D	Delayed B sweep
X-Y	X-Y display mode
A Sweep time:	50ns/div to 0.5s/div in 22 ranges, in 1-2-5 sequence, vernier control provides fully adjustable sweep time between steps.
B Sweep time:	50ns/div to 50ms/div in 19 ranges, in 1-2-5 sequence.
Accuracy:	±3% (10 ~ 35°C) ±6% (0 ~ 50°C)
Sweep magnification:	X10 ±5% (10 ~ 35°C) ±7% (0 ~ 50°C)

SPECIFICATIONS

Linearity: 50ns/div to 0.5s/div ±3% (±5% with X10 magnification)

HOLDOFF: Continuously adjustable for A Sweep hold off time from NORM to X5.

Trace separation: B Sweep can be separated from A Sweep up to 4 divisions, continuously adjustable.

Delay method: Continuous delay, SYNC delay

Delay time: 0.2 to 10 times the A SWEEP TIME/DIV setting, countinuously adjustable.

Time difference measurement accuracy:
±2% (10 ~ 35 °C)
±4% (0 ~ 50°C)

Delay jitter: 1/20000 of the full scale sweep time.

TRIGGERING

A TRIG

A trigger modes: AUTO, NORM, SINGLE,

Trigger source: V MODE, CH1, CH2, EXT CH3

Coupling modes: AC, LF_{REJ}, HF_{REJ}, DC, VIDEO
VIDEO-LINE sync automatically selected at sweep times of 50 μs/div to 50ns/div.
VIDEO-FRAME sync automatically selected at sweep times of 0.5s/div to 0.1ms/div.

Trigger level: ±90° adjustable

Polarity: +/−

B TRIG

Trigger source: CH1, CH2, EXT CH4, STARTS AFTER DELAY

Coupling modes: AC only

Trigger level: ±90° adjustable

Polarity: +/−

TRIGGER SENSITIVITY (A AND B)

COUPLING	FREQ RANGE	MINIMUM SYNC AMPLITUDE	
		INT	EXT
DC	DC ~ 20 MHz DC ~ 70 MHz	0.5div 1.5div	50 mV 150 mV
AC	Same as for DC but with increased minimum level below 20 Hz		
AC HF_{REJ}	Increased minimum level below 20 Hz and above 30 kHz		
AC LF_{REJ}	Increased minimum level below 30 kHz		
VIDEO	FRAME/LINE	0.5div	50 mV

AUTO: Same as above specifications for above 30 Hz.

Jitter: 1ns maximum at 70 MHz at 5ns/div sweep rate (X10 MAG on)

CALIBRATING VOLTAGE

1 kHz ±3% Positive square wave
0.3V ±1% (10 ~ 35°C)
±2% (0 ~ 50°C)

INTENSITY MODULATION

Input signal: TTL level, intensity increasing with more positive levels

Input impedance: Approx. 10 kΩ

Usable frequency range: DC to 10 MHz

Maximum input voltage: 50V (DC + AC peak)

CH1 OUTPUT (on rear panel)

Output voltage: 50 mVp-p/div (into 50Ω load)

Output impedance: Approx. 50Ω

Frequency response: DC to 70 MHz (−3 dB) (into 50Ω load)

TRACE ROTATION

Electrical, adjustable

POWER SUPPLY

Line voltage: LOW: 90 ~ 132V
HIGH: 180 ~ 264V

Line frequency: 50/60 Hz

Power consumption: Approx. 56W

DIMENSIONS

Width: 284 mm (328 mm)

Height: 138 mm (150 mm)

Depth: 400 mm (471 mm)

( ) dimensions include protrusions from basic case outline dimensions.

WEIGHT

7.4 kg

ENVIRONMENT

Operating temperature and humidity for guaranteed specifications: 10 ~ 35°C, 85% maximum RH

Full operating range: 0 ~ 50°C, 90% maximum RH

Storage temperature: −20 ~ 55°C

and humidity range: 80% maximum

Altitude:

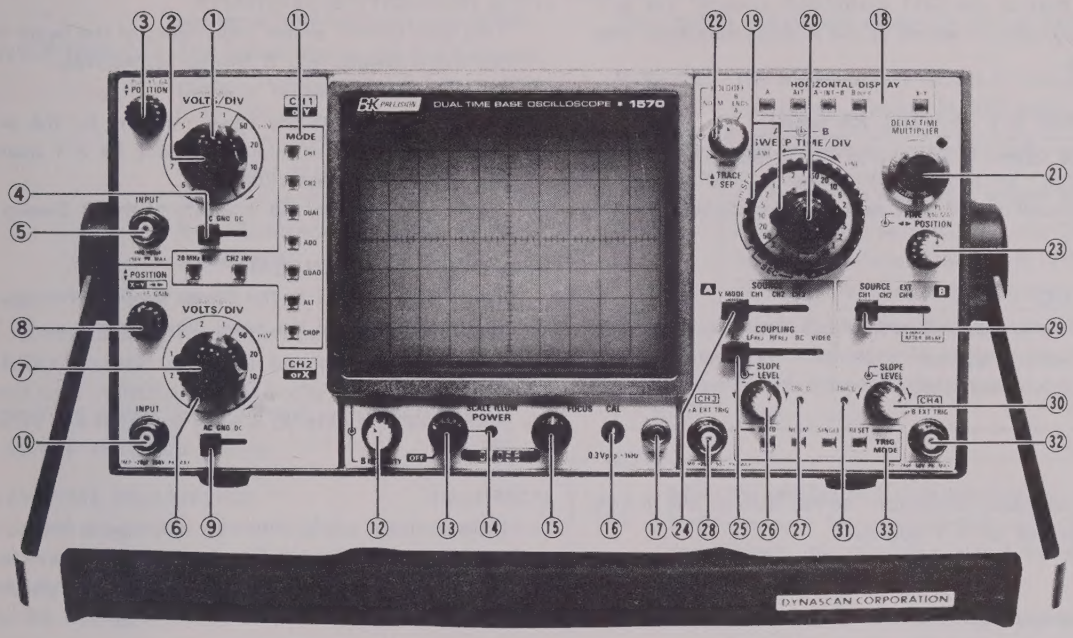
Operating: 5000 m

Non-operating: 12000 m

ACCESSORIES SUPPLIED

Two 10:1 Probes, Model PR-45
Instruction Manual
Schematic Diagram Parts List
AC power cord
Probe holder

CONTROLS AND INDICATORS



FRONT PANEL

VERTICAL AXIS CONTROL

(1)VOLTS/DIV

Vertical attenuator for channel 1; provides step adjustment of vertical sensitivity. When the VARIABLE control is turned to the CAL position, the vertical sensitivity is calibrated in 10 steps from 5V/div to 5 mV/div. For X-Y operation this control provides step adjustment of vertical sensitivity.

(2)VARIABLE

Fine adjustment control CH1 vertical attenuation. This control provides continuous adjustment between the VOLTS/DIV ranges. When set to its extreme clockwise (CAL) position, the attenuator is calibrated. For X-Y operation, this control serves as the Y-axis attenuation fine adjustment. As this fine adjuster uses a variable resistor with a center tap, the amplitude sometimes does not change during rotation.

(3)▲▼ POSITION/PULL X5 GAIN

This is a potentiometer control with an added switch function. It serves as the CH1 vertical position control for normal operation and X-Y operation as well. When pulled out, the VOLTS/DIV setting is multiplied by 5 and for X-Y operation the Y-axis sensitivity is multiplied accordingly.

In X5 GAIN mode, the vertical gain is increased and the trace becomes wider.

(4) AC-GND-DC

This switch is the CH1 vertical axis coupling mode selector, for X-Y operation, the Y-axis coupling mode control.

AC: AC input coupling, with blocking of any DC signal component.

GND: Vertical amplifier is disconnected from the input signal and connected to ground. This mode is useful in determining the zero reference.

DC: DC coupling, with both the DC and AC components of the input signal displayed on the CRT.

(5) INPUT

CH1 vertical input connector; serves also as the Y-axis input connector for X-Y operation.

(6) VOLTS/DIV

Vertical attenuator for channel 2; provides step adjustment of vertical sensitivity, when VARIABLE control is turned to the CAL position, the vertical sensitivity is calibrated in 10 steps from 5V/div. to 5 mV/div. For X-Y operation the control provides step adjustment of horizontal sensitivity.

CONTROLS AND INDICATORS

(7) VARIABLE

CH2 vertical attenuation fine adjustment. Operation is similar to that of the CH1 VARIABLE control. For X-Y operation the control serves as the X-axis attenuation fine adjustment.

(8) ▲▼ POSITION, X-Y ◄►/PULL X5 GAIN

Dual control which functions similarly to the corresponding CH1 control. In addition, it serves as the horizontal position control and X-axis sensitivity multiplier for X-Y operation.

(9) AC-GND-DC

This switch sets the CH2 vertical axis input coupling mode or the X-axis coupling mode for X-Y operation. Its operation is similar to that of the corresponding control for CH1.

(10) INPUT

CH2 vertical input connector; serves also as the X-axis input connector for X-Y operation.

(11) MODE

Vertical axis mode selection switches. LED's indicate what mode has been selected.

- CH1 — Display of CH1 input signal only.
- CH2 — Display of CH2 input signal only.
- DUAL — Display of both CH1 and CH2. For this mode either CHOP or ALT mode will be in effect, selected by the similarly named switches.
- ADD — Display of the algebraic sum of CH1 + CH2 or, if CH2 has been inverted, the difference of CH1 − CH2.
- QUAD — Display of CH1 through CH4 input signals. For this mode as well as for DUAL, either the ALT or CHOP mode is applicable and selected by the appropriately named switch.
- ALT — When DUAL or QUAD mode has been selected, 2 or 4 signal inputs are displayed in an alternating fashion.
- CHOP — Similar to ALT but input signals are displayed in a chopped fashion.
- CH2 INV — This switch inverts the polarity of the CH2 input signal.
- 20 MHzBW — This switch limits the vertical bandwidth to approximately 20 MHz when the LED is on.

> **NOTE:**
> The various vertical mode settings are related to horizontal mode and trigger source. See the sections on HORIZONTAL DISPLAY and SOURCE for a description of this relationship.

POWER SUPPLY/CRT DISPLAY CONTROLS

(12) A INTENSITY/B INTENSITY

This dual control allows adjustment of the beam intensity for the A Sweep and B Sweep respectively.

- A INTENSITY (center control) — Adjusts the beam intensity for the A Sweep and the display intensity for X-Y operation.
- B INTENSITY (outer control) — Adjusts the intensity of the B Sweep beam.

(13) POWER/SCALE ILLUM

This control serves as the power supply switch as well as the adjustment for the scale illumination.

(14) POWER

This LED indicates that the power supply has been turned on.

(15) FOCUS

Beam focus adjustment. An auto-focus circuit automatically readjusts focus as intensity is varied. Once adjusted, this control does not require frequent readjustment.

(16) CAL

This is the calibration voltage output. 0.3 Vp-p at 1 kHz is available in the form of a square wave signal.

(17) GND

Ground terminal. Oscilloscope chassis ground and earth ground via 3-wire AC power cord.

HORIZONTAL AXIS CONTROLS

(18) HORIZONTAL DISPLAY

This control is used to select the horizontal display mode. LED's indicate what mode has been selected.

- A — Only A Sweep is operative with the B Sweep dormant.
- ALT — A Sweep alternates with the B Sweep. For this mode of operation, the B Sweep appears as an intensified section on the A Sweep.
- A-INT-B — Duration of the B Sweep appears as an intensified section on the A Sweep.
- B DLY'D — Only Delayed B Sweep is operative.
- X-Y — CH1 becomes the Y-axis and CH2 the X-axis for X-Y operation.
  The settings of the vertical MODE and TRIG MODE switches have no effect.

CONTROLS AND INDICATORS

(19) A SWEEP TIME/DIV, B SWEEP TIME/DIV

A SWEEP TIME/DIV This outer control is used to set the A Sweep time in 22 ranges in 1-2-5 sequence from 50ns/div to 0.5s/div.

B SWEEP TIME/DIV This center control sets the B Sweep time in 19 ranges in 1-2-5 sequence from 50ns/div to 50ms/div. This control is constructed to make it impossible to set the B Sweep time slower than the A Sweep time. No fine adjustment is available for the B Sweep time.

(20) A VAR

This control is the innermost control on the SWEEP TIME/DIV control. It is the fine adjustment for the A Sweep time. When it is turned fully clockwise to the CAL position, the A Sweep time is calibrated to the setting of the SWEEP TIME/DIV control.

(21) DELAY TIME MULTIPLIER

This control adjusts the start time of the B Sweep to some delay time after the start of the A Sweep.

The delay time may be set to values between 0.2 and 10 times the setting of the A SWEEP TIME/DIV control.

(22) ▲▼ TRACE SEP/HOLDOFF

▲▼ TRACE SEP

This outer control allows the adjustment of the B Sweep up to 4 divisions below the A Sweep. This control has effect in the ALT mode of HORIZONTAL DISPLAY.

HOLDOFF

Rotation of this control adjusts holdoff (trigger inhibit period beyond sweep duration). Counterclockwise rotation increases holdoff period from NORM to more than five times normal. Extreme counterclockwise rotation turns on switch (B ENDS A) which causes Sweep A to terminate at the end of Sweep B when both sweeps are displayed; i.e., in A-INT-B and ALT modes of HORIZONTAL DISPLAY.

(23) ◄► POSITION/FINE, PULL X10 MAG

A combination adjustment/switch control.

This control is not used for X-Y operation.

◄► POSITION

Horizontal position coarse adjustment.

FINE, PULL X10 MAG

Rotation of control is horizontal position fine adjustment. Push-pull switch selects ten times sweep expansion (PULL 10X MAG) when pulled out. Expands Sweep A and B, increases maximum sweep rate to 5 ns/div.

TRIGGER SOURCE CONTROLS

(24) SOURCE

This control selects the source for the A Sweep Trigger.

V MODE The trigger source for the A Sweep is determined by the Vertical MODE setting.

CH1	CH1 signal is used as a trigger source
CH2	CH2 signal is used as a trigger source
ADD	The algebraic sum of CH1 and CH2 signals becomes the signal source. (If CH2 has been inverted, the difference becomes the source.)
DUAL QUAD (ALT) (CHOP)	For ALT mode the signals for CH1 through CH4 alternate as the trigger source. For the CHOP mode the chopping signal becomes the trigger source.

NOTE:

1. When the vertical MODE is selected in CHOP, the display cannot be synchronized with the input signal since the chopping signal becomes the trigger source.
2. Triggering is impossible when input signals are not applied to all channels with the vertical axis mode set to DUAL or QUAD.

CH1 CH1 signal is the trigger source for the A Sweep.

CH2 CH2 signal is the trigger source for the A Sweep.

EXT CH3 CH3 signal is the trigger source for the A Sweep.

(25) COUPLING

This control is used to select the SYNC coupling for the A trigger.

AC SYNC signal is AC coupled with any DC component blocked.

LF_{REJ} SYNC signal is coupled through a high-pass filter to eliminate low frequency components for stable triggering of high frequency signals.

HF_{REJ} SYNC signal is coupled through a low-pass filter to eliminate high frequency components for a stable triggering of low frequency signals.

DC The SYNC signal is DC coupled for SYNC which includes the effects of DC components.

For CH3 and CH4, the vertical position adjustment has no effect on the trigger point.

VIDEO For synchronization of video signals. The position of the A SWEEP TIME/DIV control determines whether FRAME or LINE is to be synced. Settings between 0.5s and 0.1ms result in FRAME while those between 50 μs and 50 ns result in LINE sync.

CONTROLS AND INDICATORS

(26) LEVEL/SLOPE

LEVEL
This outer control adjusts the level at which the A trigger causes the A Sweep to be started.

SLOPE
This inner control selects the "+" or "−" slope of the A trigger signal.

(27) TRIG'D
This green LED lights when the A Sweep is triggered. It lights for X-Y operation as well.

(28) CH3 or A EXT TRIG
Input connector for the CH3 signal. It serves also as the external A TRIG input connector. CH3 signal may be observed simultaneously with CH1, 2 and 4 signals when the QUAD mode is selected.
When the SOURCE control is set to EXT CH3, the trigger source is this input signal.

(29) SOURCE
This control selects the B Sweep trigger source.

CH1	CH1 signal is the trigger source for the B Sweep.
CH2	CH2 signal is the trigger source for the B Sweep.
EXT CH4	CH4 signal is the trigger source for the B Sweep.
STARTS AFTER DELAY	The B Sweep starts immediately after the delay time selected by the DELAY TIME MULTIPLIER and A SWEEP TIME/DIV control, regardless of the TRIG LEVEL setting.

NOTE:
If SOURCE switch is set to CH1, CH2, or EXT CH4 while AUTO trigger mode is selected, operation automatically reverts to STARTS AFTER DELAY in the absence of a proper trigger signal for the B Sweep.

(30) LEVEL/SLOPE

LEVEL
This outer control adjusts the level at which the B trigger signal causes the start of the B Sweep.

SLOPE
This control selects the "+" or "−" slope of the B trigger signal.

(31) TRIG'D
This green LED lights when the B Sweep is triggered.

(32) CH4 or B EXT TRIG
Input connector for the CH4 signal; serves also as the B TRIG external input connector. CH4 signal may be observed simultaneously with CH1, 2 and 3 signals when the QUAD mode is selected. When the SOURCE select control is set to EXT CH4, the trigger source is this input signal.

(33) TRIG MODE
This control selects the Trigger Mode. A corresponding LED lights to indicate which mode has been selected.

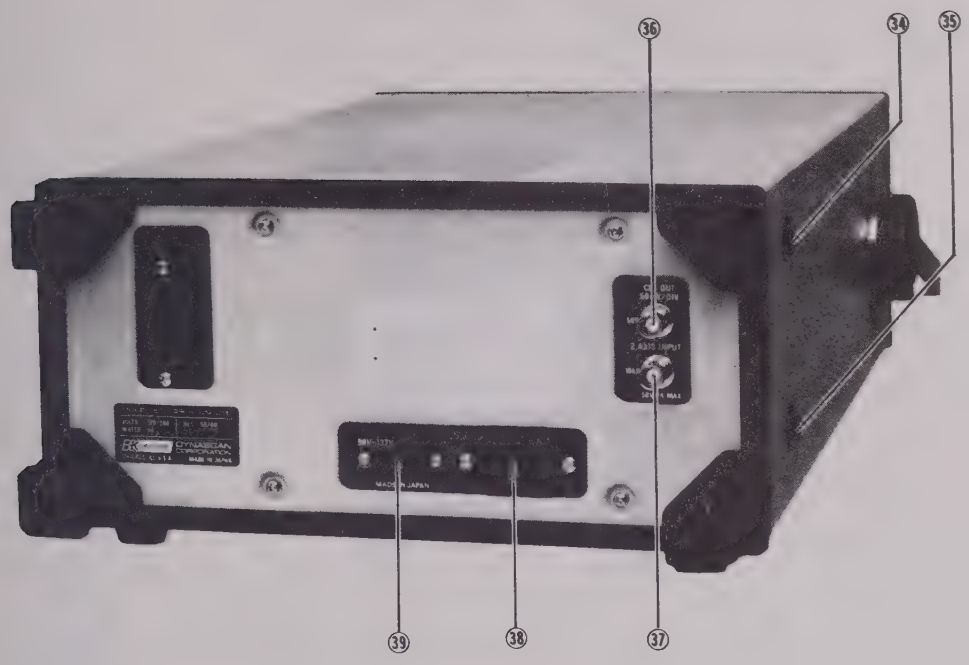
AUTO	Sweep is initiated in triggered operation but the trace is swept even in the absence of a trigger signal. Applicable to both A and B Sweep.
NORM	Triggered operation but no trace is presented when a proper trigger signal is not applied.
SINGLE	Single sweep operation. Note that in this mode, simultaneous observation of both the A and B Sweeps is not possible.

NOTE:
For dual or quad trace, single sweep operation MODE must not be set to ALT. Use the CHOP mode instead.

RESET	This is the reset button for single sweep operation. Its LED remains lighted until the main A Sweep ends.

CONTROLS AND INDICATORS

SIDE PANEL AND REAR PANEL CONTROLS



(34) CH3 POSITION

This adjustment controls the vertical position of the CH3 signal on the CRT display.

(35) CH4 POSITION

Similar to the CH3 POSITION control but for CH4.

(36) CH1 OUT

The CH1 vertical output signal connector, 50 mV/div. into 50Ω.

For cascaded operation this output is connected to the CH2 input.

(37) Z. AXIS INPUT

External intensity modulation input connector. TTL level input: intensity increases for increasing positive inputs.

(38) POWER LINE CONNECTOR

The input connector for the AC power cord.

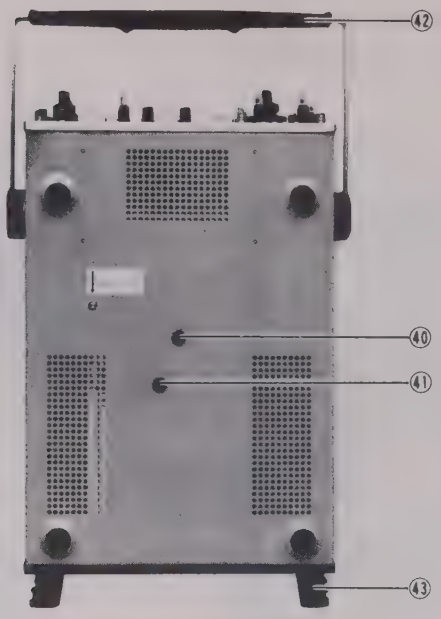
(39) LINE VOLTAGE SWITCH

This switch is used to select the power supply input voltage.

LOW	90 ~ 132VAC
HIGH	180 ~ 264VAC

CONTROLS AND INDICATORS

BOTTOM PANEL



(40) TRACE ROTATION

This control is used to compensate for trace rotation distortion.

(41) ASTIG

This control is used to compensate for trace or spot astigmatism.

(42) Handle/Tilt Stand

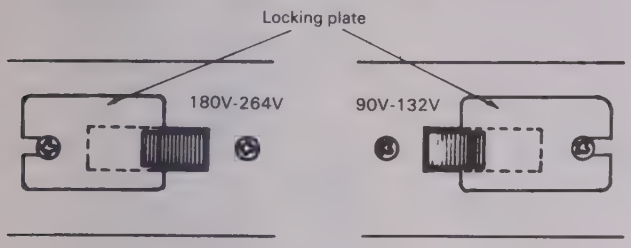
(43) Feet/Cord Wrap

OPERATION

LINE VOLTAGE SELECTION

Before applying power to the oscilloscope, make sure the 90-132/180-264 switch on the rear panel of the oscilloscope is set for the correct line voltage. Applying the wrong line voltage may damage the power supply. To change the line voltage setting:

1. Remove screw and locking plate.
2. Set switch to opposite position.
3. Replace locking plate on opposite side of switch.



SAFETY PRECAUTIONS

1. When the oscilloscope is used to make measurements in equipment that contains high voltage, there is always a certain amount of danger from electric shock. The person using the oscilloscope in such conditions should be a qualified electronics technician or otherwise trained and qualified to work in such circumstances. Observe the "Test Instrument Safety" recommendations listed on the inside front cover of this manual.
2. The ground wire of the 3-wire ac power plug places the chassis and housing of the oscilloscope at earth ground. Do not attempt to defeat the ground wire connection or float the oscilloscope; to do so may pose a great safety hazard.
3. Special precautions are required to measure or observe line voltage waveforms with any oscilloscope. Use the following procedure:
   a. Do not connect the ground clip of the probe to either side of the line. The clip is already at earth ground and touching it to the hot side of the line may "weld" or "disintegrate" the probe tip and cause possible injury, plus possible damage to the scope and probe.
   b. Insert the probe tip into one side of the line voltage receptacle, then the other. One side of the receptacle should be "hot" and produce the waveform. The other side of the receptacle is grounded and no waveform will result.

EQUIPMENT PROTECTION PRECAUTIONS

1. Do not leave the beam stationary for long periods. The screen may become permanently burned.
2. Excessive voltage applied to the input jacks may damage the oscilloscope. The maximum voltage ratings of the inputs are as follows:
   CH1 and CH2:
   500 volts p-p or 250 volts dc + ac peak.
   CH3 or CH4:
   50 volts dc + ac peak.
   Z Axis Input:
   50 volts dc + ac peak.
   When using 10:1 attenuation probes, the voltage at 1 MΩ scope inputs is only 1/10 of that at the point of measurements; however, do not exceed the probe rating (typically 500 volts dc + ac peak) at the point of measurement.
3. Do not rest objects on top of the unit or otherwise obstruct the cooling vents, since this will increase the operating temperature inside the case.
4. Always connect a cable from the ground terminal of the oscilloscope to the chassis of the equipment under test. Without this precaution, the entire current for the equipment under test may be drawn through the probe clip leads under certain circumstances. Such conditions could also pose a safety hazard, which the ground cable will prevent.
5. The probe ground clips are at oscilloscope chassis ground and should be connected only to the common of the equipment under test. To measure with respect to any point other than the common, use the ADD mode and CH2 INV (for CH1 — CH2 operation), with the channel 1 probe to the point of measurement and the channel 2 probe to the point of reference.

OPERATION

OPERATING TIPS

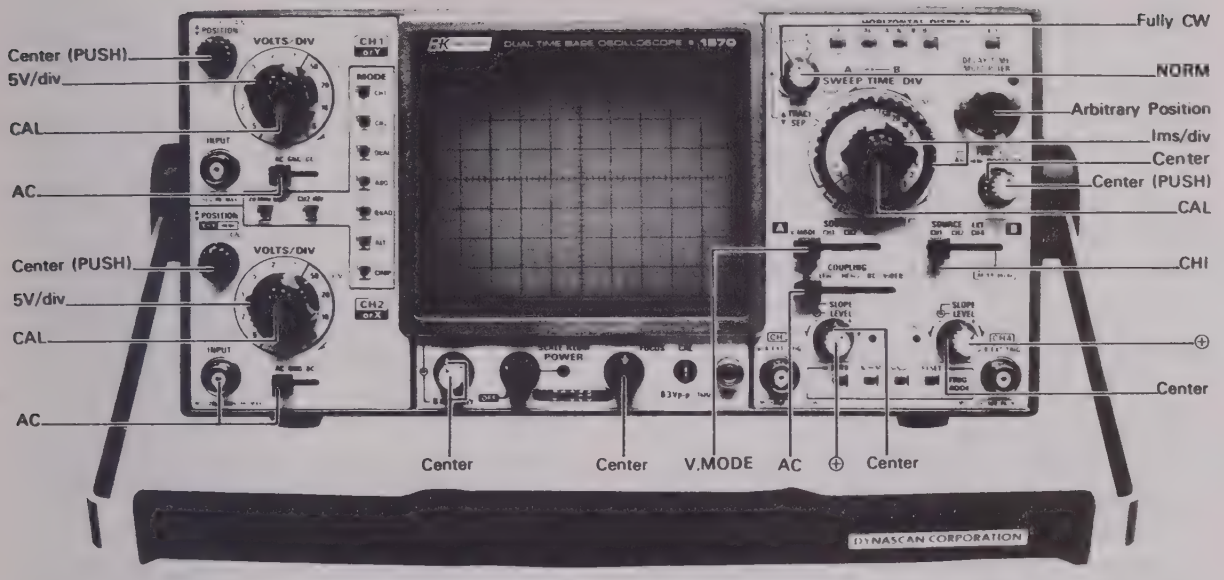
1. A good understanding of the functions of the operating controls will help you obtain the most desired display and prevent incorrect operation. The vertical mode, horizontal mode, trigger mode, and trigger source selection are interrelated, and this highly versatile scope permits almost all possible combinations to be selected. Although some of these combinations are rarely used, the versatility is available for special testing situations. Of course, the numerous combinations also provide more opportunity for incorrect operation; thus, the importance of fully understanding operation. If you cannot obtain a display or the display is different than expected, review the operating instructions in this manual.
2. The following operating conditions should be avoided when possible:

   Direct sunlight.
   High temperature and humidity.
   Mechanical vibration.

   Electrical noise and strong magnetic fields, such as near large power supplies, transformers, electric motors, etc.
3. A large value capacitor provides mode selection memory while the scope is turned off. When the scope is again turned on, mode selection will be the same as when it was turned off. If no mode selection LED's are lighted when the unit is first turned on, the capacitor is probably discharged. If this occurs, select the desired modes and the LED's should light.
4. Always use the probe ground clips for best results, attached to a circuit ground near the point of measurement. Do not rely solely on an external ground wire in lieu of the probe ground clips, as undesired signals may be induced.
5. Probe compensation adjustment matches the probe to the input of the scope. For best results, compensation of all probe ground clips, as undesired signals may be induced. always used with channel 1 and channel 2 respectively. Probe compensation should be readjusted whenever a substitute probe is used or the probes are interchanged. Adjust the compensation trimmer on each probe for the best quality waveshape (minimum overshoot, rounding off, and tilt) while observing the calibration square wave from the CAL terminal.

OPERATION

INITIAL CONTROL SETTINGS



NORMAL SWEEP DISPLAY OPERATION

1. Turn the POWER control (13) clockwise — the power supply will be turned on and the pilot lamp will light with the other LED's for the previously set MODE (11), HORIZONTAL DISPLAY (18) and TRIG MODE (33) also lighting.

   Set these modes as follows:

MODE (11)	: CH1
HORIZONTAL DISPLAY (18)	: A
TRIG MODE (33)	: AUTO

2. The trace will appear in the center of the CRT display and can be adjusted by the CH1 ▲▼ POSITION (3) and ◄► POSITION (23) controls. Next, adjust the A INTENSITY (12) and, if necessary, the FOCUS (15) for ease of observation.
3. Vertical Modes.
   With MODE (11) set to CH1, apply an input signal to the CH1 INPUT (5) jack and adjust the VOLTS/DIV (1) control for a suitable size display of the wareform.
   Operation with a signal applied to the CH1 INPUT (5) jack and the MODE set to CH2 is similar to the above procedure.

In the ADD mode, the algebraic sum of CH1 + CH2 is displayed. If the CH2 INV switch has been pressed, the algebraic difference of the two waveforms, CH1 — CH2, is displayed. If both channels are set to the same VOLTS/DIV, the sum or difference can be read directly in VOLTS/DIV from the CRT.

The DUAL mode allows simultaneous observation of CH1 and CH2 waveforms. In the DUAL mode, either the CHOP or ALT mode applies and must be selected. In the ALT mode, one sweep displays the CH1 signal and the next sweep displays the CH2 signal in an alternating sequence. In the CHOP mode, the sweep is chopped at an approximate 250 kHz rate and switched between CH1 and CH2. Note that in the CHOP mode of operation with the SOURCE switch set to V. MODE, the trigger source becomes the chopping signal itself, making waveform observation impossible. Use ALT mode instead in such cases, or select a trigger SOURCE of CH1, CH2, or CH3.

The QUAD mode is similar to the DUAL mode, except it allows simultaneous viewing of CH1 thru CH4 input signals, in either ALT or CHOP fashion. The CH3 and CH4 POSITION controls (34 and 35) become effective in the QUAD mode for adjusting the vertical position of the CH3 and CH4 traces. The CH3 and CH4 INPUTs are dc coupled

and have a sensitivity of 0.1 V/div. In quad-trace operation, a convenient viewing height is about 1 to 2 divisions for each waveform. Thus, the most desirable input level is 0.1 to 0.2 volts p-p, with a dc component of 0.5 volt or less. If 10:1 probes are used, a 1 to 2 volts p-p signal is appropriate, with a dc component of up to 5 volts, which is suitable for TTL level signals. External attenuators or blocking capacitors may be used with channel 3 and 4 if desired.

4. Triggering (using A trigger group controls).
   The SOURCE switch (29) selects the signal to be used as the sync trigger. When the V. MODE position is selected, the trigger source is dependent upon the vertical MODE selection. In this manner, each waveform being observed becomes its own trigger signal; e.g., when the vertical MODE is changed from CH1 to CH2, the source signal is also changed from CH1 to CH2. This also permits synchronization of waveforms (even without a timing relationship) in the DUAL and QUAD modes. However, when phase or timing comparison is desired in DUAL and QUAD modes, all waveforms must be triggered by the same source, and the V. MODE position is unsuitable. Also, as explained previously, CHOP cannot be used in conjunction with V. MODE in DUAL or QUAD modes.
   If the SOURCE switch is set to the CH1 (or CH2) position, the channel 1 (or channel 2) input signal is the trigger source, regardless of the vertical mode. CH1 (or CH2) is often used as the trigger source when timing comparison is desired.
   If the SOURCE switch is set to the CH3 position, the signal applied to the CH3 or A EXT TRIG jack becomes the trigger source. This signal must have a timing relationship to the displayed waveforms for a synchronized display. In QUAD mode, the signal applied to the CH3 or A EXT TRIG jack becomes both the trigger source and the displayed channel 3 signal.
   After setting the SOURCE switch, adjust the LEVEL/SLOPE control (30) to set the trigger point. Sync is indicated by the green TRIG'D LED lighting.
   As necessary to obtain a stable, synchronized display, adjust the HOLDOFF (22) and COUPLING (25) controls.
5. Adjust the A SWEEP TIME/DIV control (19) for an appropriate display of the signal input. If required, use the A VAR control (20) as well.
6. This completes the operating procedure for normal A Sweep display.

MAGNIFIED SWEEP OPERATION

Since merely shortening the sweep time to magnify a portion of an observed waveform can result in the desired portion disappearing off the screen, such magnified display should be performed using the MAGNIFIED SWEEP.

Procedure:
Using the ◄► POSITION control, adjust the desired portion of waveform to the center of the CRT. Pull out the FINE PULL X10 MAG (23) control to magnify the display 10 times. For this type of display the sweep time is the SWEEP TIME/DIV setting divided by 10.

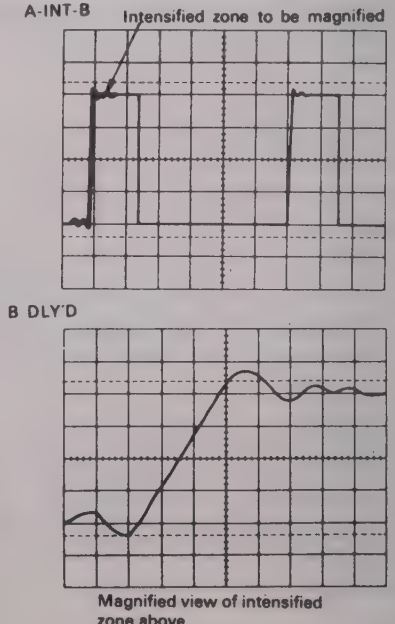
DELAYED SWEEP OPERATION

Delayed sweep operation is achieved by use of both the A Sweep and the B Sweep.

Procedure:

1. First set the HORIZONTAL DISPLAY to A and adjust for a normal waveform display.
2. Set the B SOURCE (29) switch to STARTS AFTER DELAY mode.
   Set the HORIZONTAL DISPLAY to the A-INT-B mode and the B Sweep will appear as an intensified portion of the A Sweep.
   The B Sweep intensity is adjusted using the B INTENSITY control (12), and the length of the intensified portion is adjusted by the B SWEEP TIME/DIV control.
3. Shift the intensified portion of waveform (section to be magnified) along the A Sweep by use of the DELAY TIME MULTIPLIER (21).
4. Set the HORIZONTAL DISPLAY to B DLY'D to display the A-INT-B intensified portion as a magnified B DLY'D sweep.

   Delay Time (magnified portion) = DELAY TIME MULTIPLIER setting × A SWEEP TIME/DIV setting.
5. For STARTS AFTER DELAY operation, apparent jitter increases as magnification increases. To obtain a jitter free display, set the B SOURCE switch in a position similar to that of the corresponding for A SOURCE. In this mode the signal selected by the B SOURCE switch (29) becomes the B trigger source, making use of the B LEVEL (30) control to set the trigger point.
   The B SOURCE, and LEVEL SLOPE controls now have effect and are set in a manner similar to that of the corresponding controls for A Sweep.



Magnified view of intensified zone above.

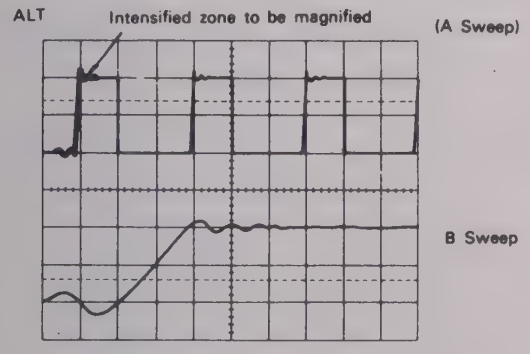
Note that for this type of operation both the DELAY TIME MULTIPLIER and TRIG LEVEL affect the start of the sweep so that the delay time is used as a reference point.

ALTERNATING SWEEP OPERATION

A Sweep and B Sweep are usable in an alternating fashion making it possible to observe both the normal and magnified waveform simultaneously.

Procedure:

1. Set the HORIZONTAL DISPLAY to A and adjust for a normal waveform display.
2. Set the B SOURCE switch to STARTS AFTER DELAY and set the HORIZONTAL DISPLAY to ALT. Adjust TRACE SEP (22) for easy observation of both the A and B traces. The upper trace is the non-magnified portion of the waveform with the magnified portion super-imposed as an intensified section. The lower waveform is the intensified portion displayed magnified.
   B INTENSITY can be used to adjust the intensity of the super-imposed waveform.
3. The DELAY TIME MULTIPLIER can be used to continuously slide the magnified portion of the waveform across the A Sweep period to allow magnification of precisely the desired portion of waveform.
4. Apparent display jitter increases with increased magnification as is the case with delayed sweep discussed above. By cancelling the STARTS AFTER DELAY switch, the B LEVEL control can be used to set the trigger point.



X-Y OPERATION

Procedure:

Set the HORIZONTAL DISPLAY control to the X-Y mode. In this mode the CH1 input becomes the Y-axis input and the CH2 input the X-axis input for X-Y display.

For X-Y operation the X and Y positions are adjusted using the CH2 ▲▼ POSITION X-Y ◄► and CH1 ▲▼ POSITION controls respectively.

X and Y sensitivity is set by using the CH2 and CH1 VARIABLE, VOLTS/DIV controls respectively.

By pulling out the two above mentioned POSITION controls, the sensitivity of both the X and Y axis is magnified by 5 times.

The A INTENSITY control is used to adjust the intensity of the display during X-Y operation.

SINGLE SWEEP OPERATION

This mode of display is useful for looking at non-synchronous or one time events.

Procedure:

1. Set the TRIG MODE to either AUTO or NORM.
   Apply a signal of approximately the same amplitude and frequency as the signal that is to be observed as the trigger signal and set the trigger level.
2. Set TRIG MODE to SINGLE and press the RESET button — observe that the green LED lights to indicate the reset condition. This LED goes out when the A Sweep period is completed.
3. After the above set-up is completed the scope is ready to operate in the SINGLE sweep mode of operation after resetting the instrument using the RESET button. Input of the trigger signal results in one and only one sweep.

CAUTION:

With the HORIZONTAL DISPLAY set to ALT, the simultaneous observation of the A Sweep and B Sweep waveforms at SINGLE SWEEP mode is not possible. Also for DUAL or QUAD operation simultaneous observation is not possible using ALT mode. Set the unit to the CHOP mode in this case.

DUAL AND QUAD TRACE OPERATION

By setting the MODE to DUAL or QUAD, Dual and Quad trace operation can be achieved. Additionally, setting HORIZONTAL DISPLAY to ALT produces up to 8 traces.

Operation of the various controls for this type of display mode similar to the operation described above for Alternating Sweep Operation.

CASCADED OPERATION

This mode of operation is used when sensitivity greater than 1 mV/div is required.

Procedure:

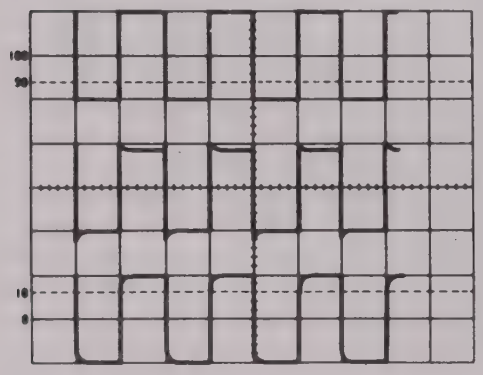
1. Connect the CH1 output to the CH2 input using a BNC cable. In this case, terminate the 50Ω termination to CH2 input.
2. For cascade operation depress the CH1 and CH2 × 5 GAIN switches.
3. Set the V MODE to CH2.
4. Set the CH1 and CH2 VOLTS/DIV to 5 mV and input a signal for a sensitivity of 500 μV/div on CH1.

APPLICATIONS

PROBE COMPENSATION

If accurate measurements are to be made, the effect of the probe being used must be properly adjusted output of the measurement system using the internal calibration signal or some other squarewave source.

1. Connect the probe to the channel to be used and set the various controls for a normal A sweep display.
2. Adjust the SWEEP TIME/DIV control display of several cycles of the signal from the calibration output, CAL, terminal.
3. Adjust the probe compensation control for a proper waveform display.
4. The other channels are compensated for in the same way. Note that for CH3 and CH4 the sensitivity is 0.1V/DIV so that when using a 10:1 probe sufficient waveform amplitude is not available, so that an alternate squarewave signal generator must be used for the compensating procedure.



TRACE ROTATION COMPENSATION

Rotation from a horizontal trace position can be the cause of measurement errors.

Adjust the controls for a normal display. Set the AC-GND-DC switch to GND and TRIG MODE to AUTO.

Adjust the ▲▼ POSITION control such that the trace is over the center horizontal graduation line.

If the trace appears to be rotated from horizontal, align it with the center graduation line using the TRACE ROTATION control located on the bottom of the instrument.

DC VOLTAGE MEASUREMENTS

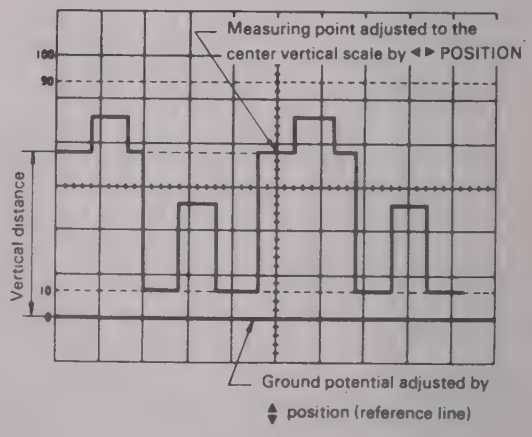
This procedure describes the measurement procedure for DC waveforms.

Procedure:

1. Connect the signal to be measured to the INPUT connector and set the V MODE to the channel to be used. Set the VOLTS/DIV and SWEEP TIME/DIV switch to obtain a normal display of the waveform to be measured. Set the VARIABLE control to the CAL position.
2. Set TRIG MODE to AUTO and AC-GND-DC to the GND position, which establishes the zero volt reference. Using the ▲▼ POSITION control, adjust the trace position to the desired reference level position, making sure not to disturb this setting once made.
3. Set the AC-GND-DC switch to the DC position to observe the input waveform, including its DC component. If an appropriate reference level or VOLTS/DIV setting was not made, the waveform may not be visible on the CRT screen at this point. If so, reset VOLTS/DIV and/or the ▲▼ POSITION control to locate.
4. Use the ◄► POSITION control to bring the portion of the waveform to be measured to the center vertical graduation line of the CRT screen.
5. Measure the vertical distance from the reference level to the point to be measured, (the reference level can be rechecked by setting the AC-GND-DC switch again to GND).
   Multiply the distance measured above by the VOLTS/DIV setting and the probe attenuation ratio as well. If "×5 GAIN" has been set multiply the value by 1/5 as well.
   Voltages above and below the reference level are positive and negative values respectively.

Using the formula:

DC level = Vertical distance in divisions × (VOLTS/DIV setting) × (probe attenuation ratio) × "×5 GAIN" value^{-1} (1/5)


Measuring point adjusted to the center vertical scale by ◄► POSITION
Vertical distance
Ground potential adjusted by ▲▼ position (reference line)

[EXAMPLE]

For the example, the point being measured is 3.8 divisions from the reference level (ground potential).

If the VOLTS/DIV was set to 0.2V and a 10:1 probe was used.

Substituting the given values-

DC level = 3.8 (div) × 0.2(V) × 10 = 7.6V

APPLICATIONS

MEASUREMENT OF THE VOLTAGE BETWEEN TWO POINTS ON A WAVEFORM

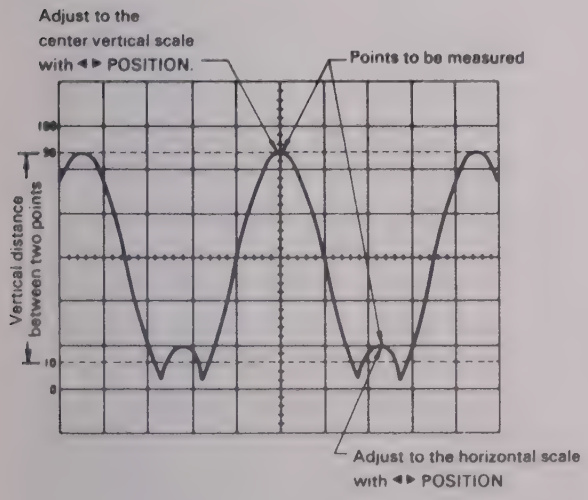
This technique can be used to measure peak-to-peak voltages.

Procedure:

1. Apply the signal to be measured to the INPUT, set the V MODE to the channel to be used and AC-GND-DC to AC, adjusting VOLTS/DIV and SWEEP TIME/DIV for a normal display. Set VARIABLE to the CAL position.
2. Using the ▲▼ POSITION control adjust the waveform position such that one of the two points falls on a CRT graduation line and that the other is visible on the display screen.
3. Using the ◄► POSITION control, adjust the second point to coincide with the center vertical graduation line.
4. Measure the vertical distance between the two points and multiply this by the setting of the VOLTS/DIV control.
   If a probe is used, further multiply this by the attenuation ratio, if any and if "×5 GAIN" is used, multiply the value by 1/5 as well.

Using the formula:

Volts Peak-to-Peak
= Vertical distance (div) × (VOLTS/DIV setting)
× (probe attenuation ratio) × "×5 GAIN" value^{-1}
(1/5)



[EXAMPLE]

For the example, the two points are separated by 4.4 divisions vertically. Let the VOLTS/DIV setting be 0.2V/div and the probe attenuation be 10:1.

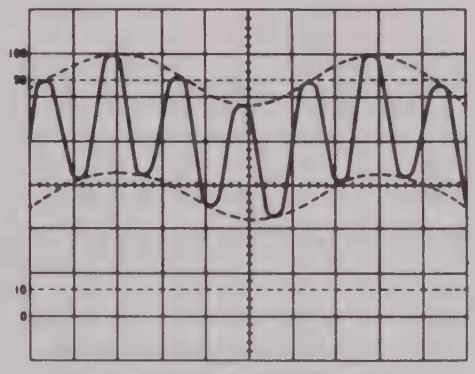
Substituting the given value:
Voltage between two points = 4.4 (div) × 0.2 (V) × 10 = 8.8V

ELIMINATION OF UNDESIRED SIGNAL COMPONENTS

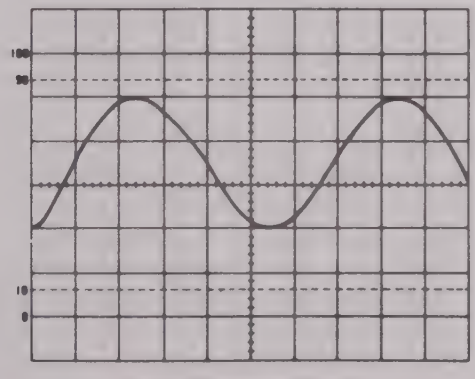
The ADD feature can be conveniently used to cancel out the effect of an undesired signal component which is superimposed on the signal you wish to observe.

Procedure:

1. Apply the signal containing an undesired component to the CH1 INPUT and the undesired signal itself alone to the CH2 INPUT.
2. Set the V MODE to DUAL (CHOP) and SOURCE to CH2. Verify that CH2 represents the unwanted signal in reverse polarity. If necessary reverse polarity by setting CH2 to INV.
3. Set V MODE to ADD, SOURCE to V MODE and CH2 VOLTS/DIV and VARIABLE so that the undesired signal component is cancelled as much as possible. The remaining signal should be the signal you wish to observe alone and free of the unwanted signal.

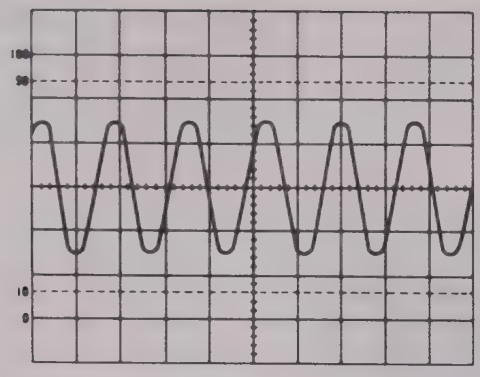


Signal containing undesired component
(Broken lines: undesired component envelope)

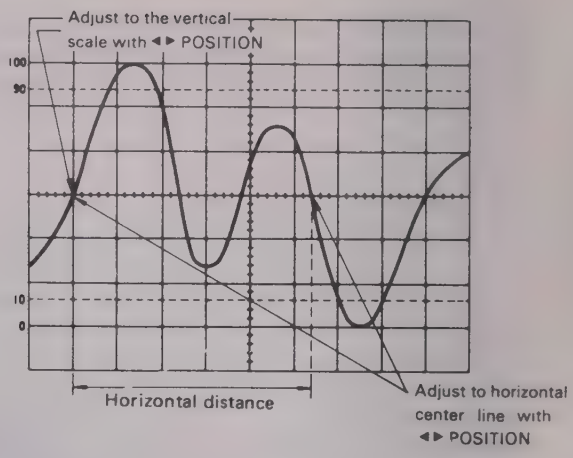


Undesired component signal

APPLICATIONS



Signal without undesired component



TIME MEASUREMENTS

This is the procedure for making time measurements between two points on a waveform. The combination of the SWEEP TIME/DIV and the horizontal distance in divisions between the two points is used in the calculation.

Procedure:

1. Apply the signal to be measured to the INPUT connector and set the V MODE to the channel to be used. Adjust VOLTS/DIV and SWEEP TIME/DIV for a normal display.
   Be sure that the VARIABLE control is set to CAL.
2. Using the ▲▼ POSITION control, set one of the points to be used as a reference to coincide with the horizontal centerline.
   Use the ◄► POSITION control to set this point at the intersection of any vertical graduation line.
3. Measure the horizontal distance between the two points.
   Multiply this by the setting of the A SWEEP TIME/DIV control to obtain the time between the two points. If horizontal " × 10 MAG" is used, multiply this further by 1/10.

Using the formula:
Time = Horizontal distance (div) × (SWEEP TIME/DIV setting) × " × 10 MAG" value^{-1} (1/10)

[EXAMPLE]

For the example, the horizontal distance between the two points is 5.4 divisions.
If the SWEEP TIME/DIV is 0.2ms/div we calculate.

Substituting the given value:
Time = 5.4 (div) × 0.2 (ms) = 1.08ms

FREQUENCY MEASUREMENTS

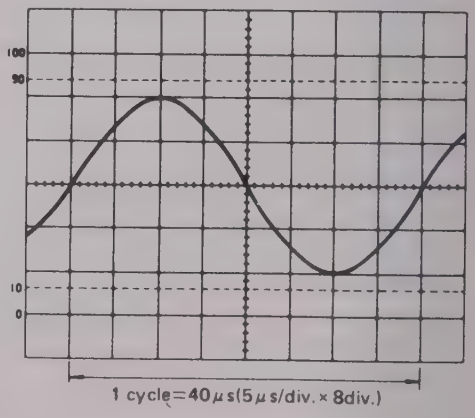
Frequency measurements are made by measuring the period of one cycle of waveform and taking the reciprocal of this time value as the frequency.

Procedure:

1. Set the oscilloscope up to display one cycle of waveform (one period).
2. The frequency is the reciprocal of the period measured.

Using the formula:

$$\text{Freq} = \frac{1}{\text{period}}$$



[EXAMPLE]

A period of 40μs is observed and measured.

Substituting the given value:
Freq = $1/[40 \times 10^{-6}] = 2.5 \times 10^{4} = 25$ kHz

APPLICATIONS

While the above method relies on the measurement directly of the period of one cycle, the frequency may also be measured by counting the number of cycles present in a given time period.

1. Apply the signal to the INPUT, setting the V MODE to the channel to be used and adjusting the various controls for a normal display. Set A VAR to CAL.
2. Count the number of cycles of waveform between a chosen set of vertical graduation lines.
   Using the horizontal distance between the vertical lines used above and the SWEEP TIME/DIV the time span may be calculated. Multiply the reciprocal of this value by the number of cycles present in the given time span. If "× 10 MAG" is used multiply this further by 10.
   Note that errors will occur for displays having only a few cycles.

Using the formula:

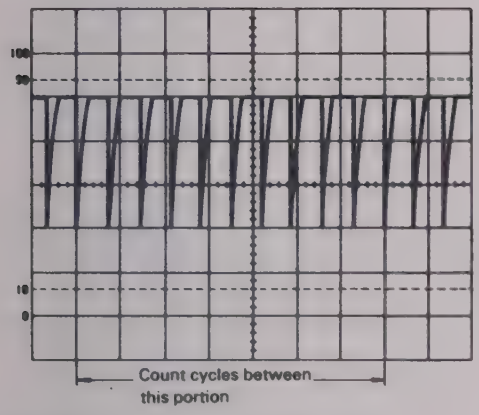
$$\text{Freq} = \frac{\text{\# of cycles} \times \text{"} \times \text{10 MAG" value}}{\text{Horizontal distance (div)} \times \text{SWEEP TIME/DIV setting}}$$

[EXAMPLE]

For the example, within 7 divisions there are 10 cycles.
The SWEEP TIME/DIV is 5μs.

Substituting the given value:

$$\text{Freq} = \frac{10}{7 \times 5\ (\mu s)} \fallingdotseq 285.7\ \text{kHz}$$



PULSE WIDTH MEASUREMENTS

Procedure:

1. Apply the pulse signal to the INPUT and set the V MODE to the channel to be used.
2. Use VOLTS/DIV, VARIABLE and ▲▼ POSITION to adjust the waveform such that the pulse is easily observed and such that the center pulse width coincides with the center horizontal line on the CRT screen.
3. Measure the distance between the intersection of the pulse waveform and the center horizontal line in divisions. Be sure that the A VAR is in the CAL position. Multiply this distance by the A SWEEP TIME/DIV and by 1/10 is "× 10 MAG" mode is being used.

Using the formula:

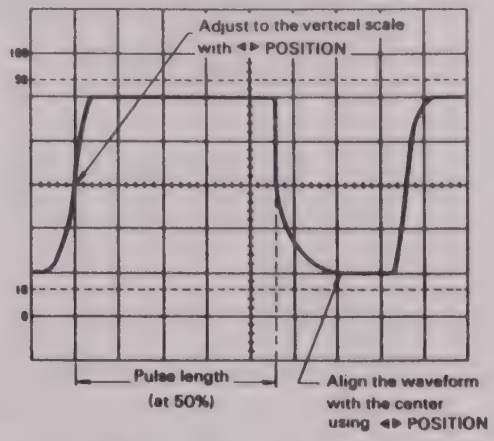
Pulse width = Horizontal distance (div) × (SWEEP TIME/DIV setting) × "× MAG 10" value^{-1} (1/10)

[EXAMPLE]

For the example, the distance (width) at the center horizontal line is 4.6 divisions and the A SWEEP TIME/DIV is 0.2ms.

Substituting the given value:

Pulse width = 4.6 (div) × 0.2ms = 0.92ms



PULSE RISETIME AND FALLTIME MEASUREMENTS

For risetime and falltime measurements, the 10% and 90% amplitude points are used as starting and ending reference points.

Procedure:

1. Apply a signal to the INPUT and set V MODE to the channel to be used.
   Use VOLTS/DIV and VARIABLE to adjust the waveform peak to peak height to six divisions.
2. Using the ▲▼ POSITION control and the other controls, adjust the display such that the waveform is centered vertically in the display. Set the SWEEP TIME/DIV to as fast a setting as possible consistent with observation of both the 10% and 90% points. Set the A VAR to the CAL position.
3. Use the ◄► POSITION control to adjust the 10% point to coincide with a vertical graduation line and measure the distance in divisions between the 10% and 90% points on the waveform. Multiply this by the SWEEP TIME/DIV and also by 1/10, if "× 10 MAG" mode was used.

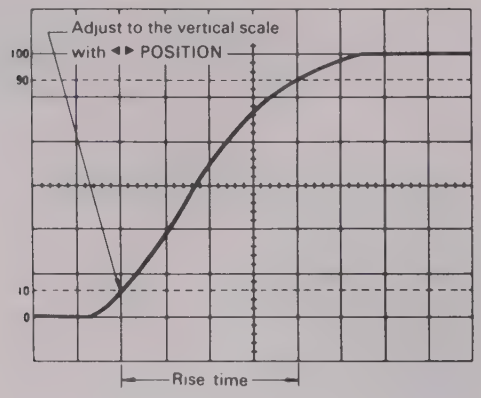
CAUTION

Be sure that the correct 10% and 90% lines are used. For such measurements the 0, 10, 90 and 100% points are marked on the CRT screen.

Using the formula:

Risetime = Horizontal distance (div) × (SWEEP TIME/DIV setting) × "× 10 MAG" value^{-1} (1/10)

APPLICATIONS



[EXAMPLE]

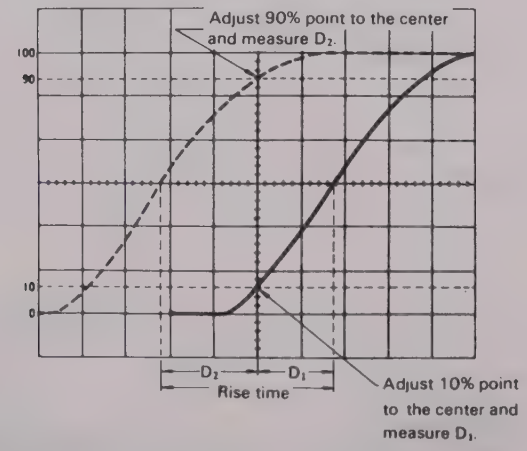
For the example, the horizontal distance is 4.0 divisions. The SWEEP TIME/DIV is 2μs.

Substituting the given value:
Risetime = 4.0 (div) × 2 (μs) = 8μs

Risetime and falltimes can be measured by making use of the alternate step 3' as described below as well.

4. Use the ◄► POSITION control to set the 10% point to coincide with the center vertical graduation line and measure the horizontal distance to the point of the intersection of the waveform with the center horizontal line. Let this distance be D_1. Next adjust the waveform position such that the 90% point coincides with the vertical centerline and measure the distance from that line to the intersection of the waveform with the horizontal centerline. This distance is D_2 and the total horizontal distance is then D_1 plus D_2 for use in the above relationship in calculating the risetime or falltime.

Using the formula:
Risetime = $(D_1 + D_2)$ (div) × (SWEEP TIME/DIV setting) × "× 10 MAG" value^{-1} + 1/10)



[EXAMPLE]

For the example, the measured D_1 is 1.8 divisions while D_2 is 2.2 divisions. If SWEEP TIME/DIV is 2μs we use the following relationship

Substituting the given value:
Risetime = (1.8 + 2.2) (div) × 2 (μs) = 8μs

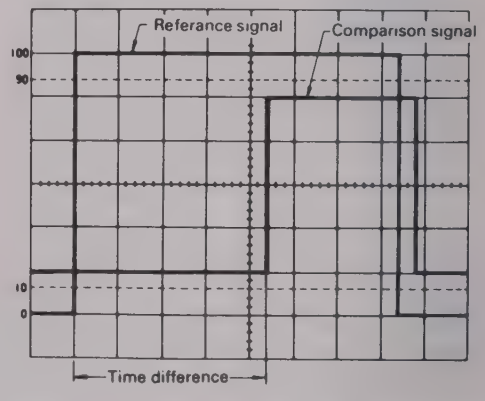
TIME DIFFERENCE MEASUREMENTS

This procedure is useful in measurement of time differences between two signals that are synchronized to one another but skewed in time.

Procedure:

1. Apply the two signals to CH1 and CH2 and set the V MODE to DUAL choosing either ALT or CHOP mode. Generally for low frequency signals CHOP is chosen with ALT used for high frequency signals.
2. Select the faster of the two signals as the SOURCE and use VOLTS/DIV and SWEEP TIME/DIV to obtain an easily observed display.
   Set A VAR to CAL.
3. Using ▲▼ POSITION control set the waveforms to the center of the CRT display and use the ◄► POSITION control to set the reference signal to be coincident with a vertical graduation line.
4. Measure the horizontal distance between the two signals and multiply this distance in divisions by the SWEEP TIME/DIV setting.
   If × 10 MAG is being used multiply this again by 1/10.

   Using the formula:
   Time = Horizontal distance (div) × (SWEEP TIME/DIV setting) × "× 10 MAG" value^{-1} (1/10)



[EXAMPLE]

For the example, the horizontal distance measured is 4.4 divisions. The SWEEP TIME/DIV is 0.2ms.

Substituting the given value:
Time = 4.4 (div) × 0.2(ms) = 0.88ms

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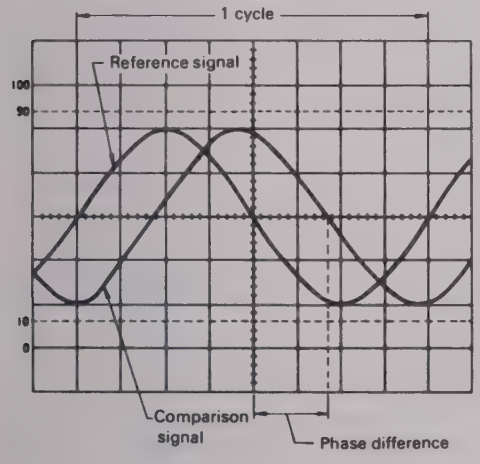
PHASE DIFFERENCE MEASUREMENTS

This procedure is useful in measuring the phase difference of signals of the same frequency.

1. Apply the two signals to the CH1 and CH2 INPUTS, setting the V MODE to DUAL and choosing either CHOP or ALT mode.
2. Set the SOURCE to the signal which is leading in phase and use VOLTS/DIV to adjust the signals such that they are equal in amplitude. Adjust the other controls for a normal display.
3. Use SWEEP TIME/DIV and A VAR to adjust the display such that one cycle of the signals occupies 8 divisions of horizontal display.
   Use the ▲▼ POSITION to bring the signals in the center of the screen.
   Having set up the display as above, one division now represents 45° in phase.
4. Measure the horizontal distance between corresponding points on the two waveforms.

Using the formula:
Phase difference = horizontal distance (div) × 45°/div



[EXAMPLE]

For the example, the horizontal distance is 1.7 divisions.

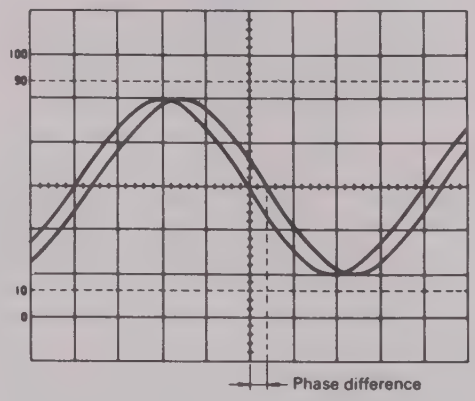
Substituting the given value:
The phase difference = 1.7 (div) × 45°/div = 76.5°

The above setup allows 45° per division but if more accuracy is required the SWEEP TIME/DIV may be changed and magnified without touching the A VAR control and if necessary the trigger level can be readjusted.

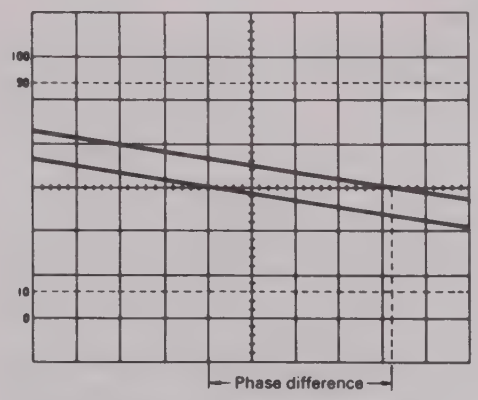
For this type of operation, the relationship of one division to 45° no longer holds. Phase difference is defined by the formula as follow.

$$\text{Phase difference} = \text{horizontal distance of new sweep range (div)} \times 45°/\text{div} \times \frac{\text{New SWEEP TIME/DIV setting}}{\text{Original SWEEP TIME/DIV setting}}$$

Another simple method of obtaining more accuracy quickly is to simply use × 10 MAG for a scale of 4.5°/div.



One cycle adjusted to occupy 8 div.



Expanded sweep waveform display.

RELATIVE MEASUREMENTS

If the frequency and amplitude of some reference signal are known, an unknown signal may be measured for level and frequency without use of the VOLTS/DIV or SWEEP TIME/DIV for calibration.
The measurement is made in units relative to the reference signal.

★Vertical Sensitivity

Setting the relative vertical sensitivity using a reference signal.

1. Apply the reference signal to the INPUT and adjust the display for a normal waveform display.

Adjust VOLTS/DIV and VARIABLE so that the signal coincides with the CRT face's graduation lines. After adjusting, be sure not to disturb the setting of the VARIABLE control.

2. The vertical calibration coefficient is now the reference signal's amplitude (in volts) divided by the product of the vertical amplitude set in step 1 and the VOLTS/DIV setting.

   Using the formula:

   Vertical coefficient

$$= \frac{\text{Voltage of the reference signal (V)}}{\text{Vertical amplitude (div)} \times \text{VOLTS/DIV setting}}$$

3. Remove the reference signal and apply the unknown signal to the INPUT, using the VOLTS/DIV control to adjust the display for easy observation. Measure the amplitude of the displayed waveform and use the following relationship to calculate the actual amplitude of the unknown waveform.

   Amplitude of the unknown signal (V)
   = Vertical distance (div) × Vertical coefficient
   × VOLTS/DIV setting

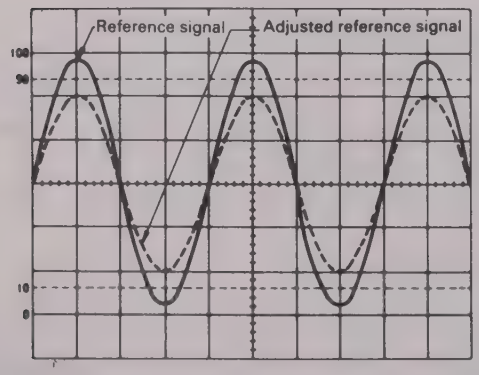
[EXAMPLE]
For the example the VOLTS/DIV is 1V.
The reference signal is 2 Vrms. Using the VARIABLE, adjust so that the amplitude of the reference signal is 4 divisions.

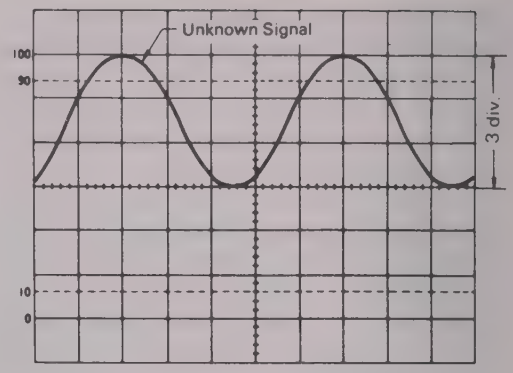
Substituting the given value:

$$\text{Vertical coefficient} = \frac{2\ \text{Vrms}}{4\ (\text{div}) \times 1\ (\text{V})} = 0.5$$

Then, measure the unknown signal and VOLTS/DIV is 2V and vertical amplitude is 3 divisions.

Substituting the given value:
Effective value of unknown signal = 3 (div) × 0.5 × 5(V)
= 7.5 V rms





★PERIOD

Setting the relative sweep coefficient with respect to a reference frequency signal.

1. Apply the reference signal to the INPUT, using VOLTS/DIV and VARIABLE to obtain an easily observed waveform display.

   Using SWEEP TIME/DIV and VARIABLE adjust one cycle of the reference signal to occupy a fixed number of scale divisions accurately. After this is done be sure not to disturb the setting of the A VAR control.

2. The Sweep (horizontal) calibration coefficient is then the period of the reference signal divided by the product of the number of divisions used in step 1 for setup of the reference and the setting of the SWEEP TIME/DIV control.

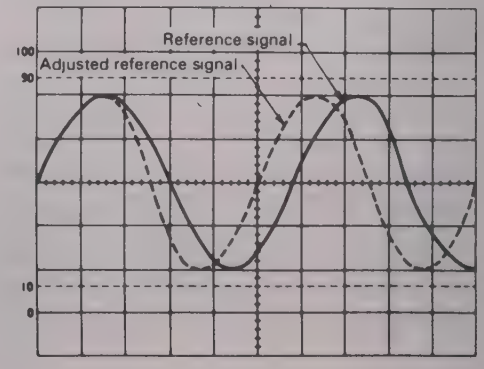
   Using the formula:

   Sweep coefficient

$$= \frac{\text{Period of the reference signal (sec)}}{\text{Horizontal width (div)} \times \text{SWEEP TIME/DIV setting}}$$

3. Remove the reference signal and input the unknown signal, adjusting the SWEEP TIME/DIV control for easy observation.
   Measure the width of one cycle in divisions and use the following relationship to calculate the actual period.

Using the formula:
Period of unknown signal = Width of 1 cycle (div) × sweep coefficient × SWEEP TIME/DIV setting



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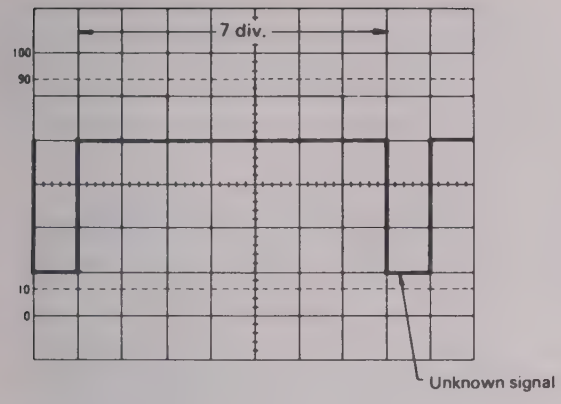


[EXAMPLE]

A SWEEP TIME/DIV is 0.1ms and apply 1.75kHz reference signal. Adjust the A VAR so that the distance of one cycle is 5 divisions.

Substituting the given value:

$$\text{Horizontal coefficient} = \frac{1.75\ (\text{kHz})^{-1}}{5 \times 0.1\ (\text{ms})} = 1.142$$

Then, SWEEP TIME/DIV is 0.2ms and horizontal amplitude is 7 divisions.

Substituting the given value:

Pulse width = 7 (div) × 1.142 × 0.2 (ms) ≒ 1.6ms

PULSE JITTER MEASUREMENTS

1. Apply the signal to the INPUT and set the V MODE to the channel to be used.
   Use VOLTS/DIV to adjust for an easy to observe waveform display. Special care should be taken to adjust the Trigger group of controls for a stable display. Set A VAR to CAL.
2. Set the HORIZONTAL DISPLAY to A-INT-B, and set the B SOURCE switch to STARTS AFTER DELAY mode. Adjust the DELAY TIME MULTIPLIER for intensified display of the waveform to be measured.
3. Using the B SWEEP TIME/DIV, adjust the display for intensification of the entire jitter area of the waveform.
4. Set the HORIZONTAL DISPLAY to B DLY'D.
   Measure the width of the jitter area.
   The jitter time is this width in divisions multiplied by the setting of the B SWEEP TIME/DIV control.

Using the formula:

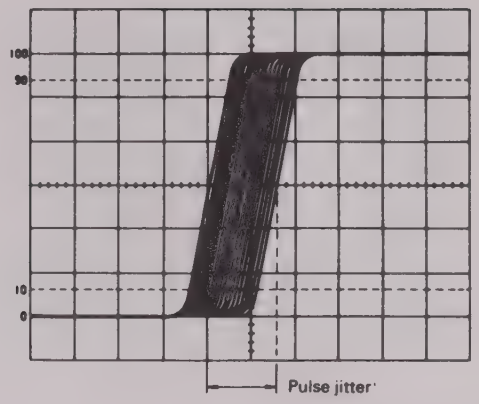
Pulse jitter = Jitter width (div) × B SWEEP TIME/DIV setting

[EXAMPLE]

The example shows a case in which the jitter width was measured at 1.6 divisions wide with the B SWEEP TIME/DIV set at 0.2μs.

Substituting the given value:

Pulse jitter = 1.6 × 0.2μs = 0.32μs



SWEEP MULTIPLICATION (MAGNIFICATION)

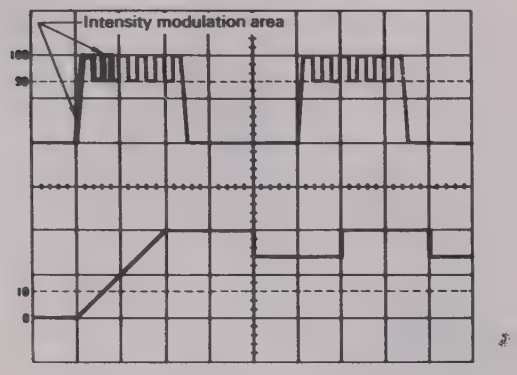
The apparent magnification of the delayed sweep is determined by the values set by the A and B SWEEP TIME/DIV controls

1. Apply a signal to the INPUT and set the V MODE to the channel to be used, adjusting VOLTS/DIV for an easily observed display of the waveform and the other controls if necessary.
2. Set the A SWEEP TIME/DIV so that several cycles of the waveform are displayed. Set the B SOURCE to STARTS AFTER DELAY mode.
   When HORIZONTAL DISPLAY is set to A-INT-B, the magnified portion of the waveform will appeared intensified on the CRT display.
3. Use the DELAY TIME MULTIPLIER to shift the intensified portion of waveform to correspond with the section to be magnified for observation. Use the B SWEEP TIME/DIV to adjust intensified portion to cover the entire portion to be magnified.
4. Set the HORIZONTAL DISPLAY to either ALT or B DLY'D and use the ▲▼ POSITION and ▲▼ TRACE SEP controls to adjust the display for easy viewing.
5. Time measurements are performed in the same manner from the B sweep as was described above for A sweep time measurements.
   The apparent magnification of the intensified waveform section is the A SWEEP TIME/DIV divided by the B SWEEP TIME/DIV.

Using the formula:

$$\text{The apparent magnification of the intensified waveform} = \frac{\text{A SWEEP TIME/DIV setting}}{\text{B SWEEP TIME/DIV setting}}$$

APPLICATIONS



[EXAMPLE]

In the example, the A SWEEP TIME is 2μs and the B SWEEP TIME is 0.2μs.

Substituting the given value:

$$\text{Apparent magnification ratio} = \frac{2 \times 10^{-6}}{0.2 \times 10^{-6}} = 10$$

With the above magnification, if the magnification ratio is increased, delay jitter will occur.
To achieve a stable display, cancel the STARTS AFTER DELAY mode and used the triggered mode of operation.

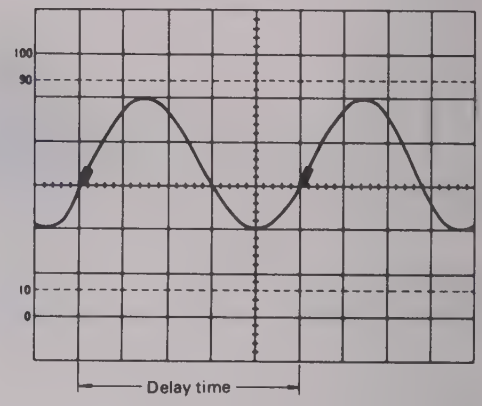
1. Perform the above steps 1 through 3.
2. Set the B SOURCE to the same signal as the A trigger source.
3. Set the HORIZONTAL DISPLAY to either ALT or B DLY'D. The apparent magnification will be the same as described above.
   If a proper B trigger signal is not applied, intensification may not occur. If this happens, vary the signal level or trigger with an external signal source.

DELAYED SWEEP TIME MEASUREMENTS

Using the B sweep, high accuracy time measurements can be made.

1. Apply a signal to INPUT and set the V MODE to the channel to be used. Adjust VOLTS/DIV and the other controls if necessary to obtain an easily observed waveform display.
   Set the A VAR to CAL.
2. Adjust the A SWEEP TIME/DIV to display the portion of waveform to be measured. Set the B SOURCE switch to STARTS AFTER DELAY mode.
   Set the HORIZONTAL DISPLAY to A-INT-B and adjust the B SWEEP TIME/DIV for as small as possible an intensified region.
3. Using the ▲▼ POSITION control adjust the waveform position so as to intersect with the center horizontal line on the CRT screen. Use the DELAY TIME MULTIPLIER so that the intensified portion of waveform touches the center horizontal line and record the setting of the DELAY TIME MULTIPLIER at this point.
4. Use the DELAY TIME MULTIPLIER to adjust intensified portion to same point of the second waveform.
   The waveform period is the second dial reading minus the first dial reading multiplied by the A SWEEP TIME/DIV setting.

Using the formula:
Period = (2nd dial reading − 1st dial reading)
× Delayed sweep time (A SWEEP TIME/DIV setting)



[EXAMPLE]

For the example the first dial setting is 1.01 and the second is 6.04. The setting of A SWEEP TIME/DIV is 2ms.

Substituting the given value:
Period = (6.04 − 1.01) × 2 (ms) = 10.06ms

PULSE WIDTH MEASUREMENTS USING DELAYED SWEEP

This method is similar to the time measurement method and can be used for high accuracy pulse width measurements.

1. Apply the pulse signal to the INPUT and set the V MODE to the channel to be used.
2. Use the VOLTS/DIV, VARIABLE and ▲▼ POSITION controls to adjust the display such that the waveform is easily observable with the center of the pulse width coinciding with the center horizontal graduation line.
   Set A VAR to CAL.
3. Set the A SWEEP TIME/DIV to display the portion of the waveform to be measured, setting the B SOURCE switch to STARTS AFTER DELAY mode.
   Set the HORIZONTAL DISPLAY to A-INT-B, and adjust the B SWEEP TIME/DIV for as short as possible an intensified section of waveform.
4. Using the DELAY TIME MULTIPLIER, adjust the display so that the intensified portion touches the center horizontal graduation line of the CRT screen and record the dial setting at this point.

5. Using the DELAY TIME MULTIPLIER adjust the falling edge of the pulse so that it touches the center horizontal graduation line and is intensified.
   The pulse width is the second dial reading minus the first dial reading multiplied by the A SWEEP TIME/DIV setting.

Using the formula:
Pulse width = (2nd dial reading−1st dial reading) × Delayed sweep time (A SWEEP TIME/DIV setting)

[EXAMPLE]

In the example, the first dial reading is 0.61 and the second is 5.78 with the A SWEEP TIME/DIV setting at 2μs.
Substituting the appropriate values

Pulse width = (5.78−0.61) × 2 (μs) = 10.34μs

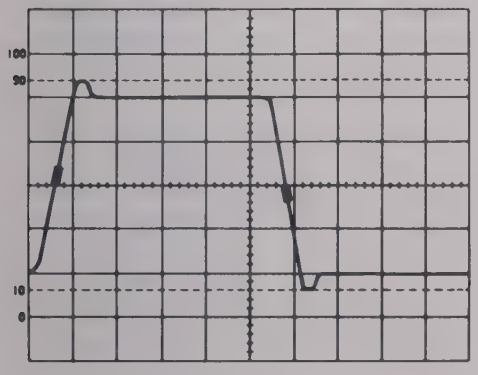
FREQUENCY MEASUREMENTS USING DELAYED SWEEP

The frequency is obtained as the reciprocal of the period of one cycle.

1. Measure the period of the waveform using the procedure described above for time measurement.
2. The frequency is then the reciprocal of the period measured.

Using the formula:

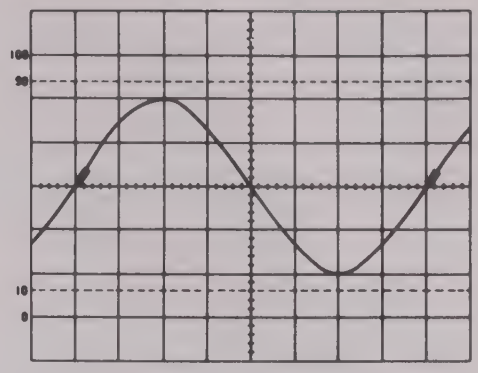
$$\text{Freq} = \frac{1}{\text{Period}}$$



[EXAMPLE]

For the example, the period measured is 40.2μs, making the frequency simply.

Substituting the given value:
Freq = $1/(40.2 \times 10^{-6}) \fallingdotseq 24.88$ kHz



PULSE REPETITION TIME

Using the delayed sweep feature, reliable time measurements can be made.

1. Apply a signal to the INPUT and set the V MODE to the channel to be used.
   Adjust VOLTS/DIV to obtain a normal easy to view display of the waveform.
2. Adjust the A SWEEP TIME/DIV so that at least two cycles of the waveform are displayed.
   Set the HORIZONTAL DISPLAY to A-INT-B and set the B SOURCE switch to STARTS AFTER DELAY mode.
   Set the B SWEEP TIME/DIV as fast a sweep speed as possible.
3. Using the DELAY TIME MULTIPLIER, adjust the intensified portion to coincide with the first pulse.
   Set the HORIZONTAL DISPLAY to ALT and use ▲▼ TRACE SEP to adjust the waveforms for easy viewing.
4. Using the DELAY TIME MULTIPLIER, set the pulse to coincide with one of the vertical graduation lines and record the dial setting at this point.
5. Again using the DELAY TIME MULTIPLIER, adjust the second pulse in the same manner to the vertical line used in step 4, recording this dial setting as well. The pulse repetition time is the second dial reading minus the first dial reading multiplied by the A SWEEP TIME/DIV control setting.

Using the formula:

Pulse repetition time = (2nd dial reading−1st dial reading) × Delayed sweep time (A SWEEP TIME/DIV setting)

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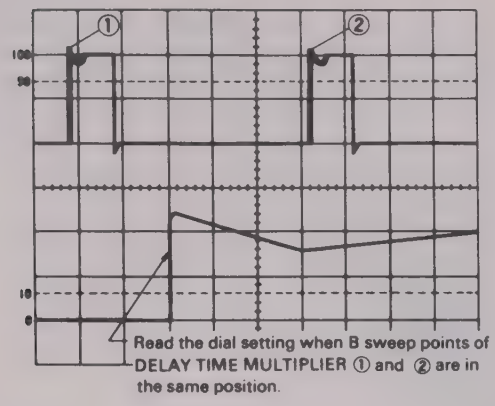


[EXAMPLE]

For the example, the first dial reading is 0.76 and the second is 6.22 with the A SWEEP TIME/DIV set at 2μs.
We have, substituting the appropriate values

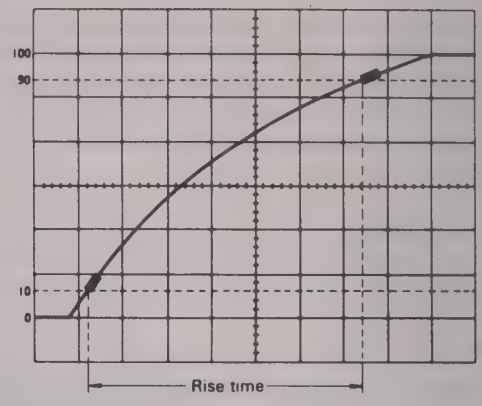
Pulse repetition time = (6.22-0.76) × 2 (μs) = 10.92μs

USING DELAYED SWEEP FOR MEASUREMENT OF RISETIMES AND FALLTIMES

Risetimes and falltimes are generally measured by using the 10% and 90% amplitude points as reference starting and ending points for the rise or fall.

1. Apply the signal to the INPUT and set the V MODE to the channel to be used.
   Use VOLTS/DIV and VARIABLE to obtain a normal 6 division high waveform display.
2. Using the ▲▼ POSITION control, set the waveform position in the central area of the screen vertically, that it to coincide with the 100% and 0% lines on the CRT screen.
   Set the SWEEP TIME/DIV to as high a speed as possible consistent with observation of both the 10% and 90% points.
   Set A VAR to the CAL position.
3. Set the B SOURCE switch to STARTS AFTER DELAY mode and adjust the B SWEEP TIME/DIV for as short as possible an intensified section of waveform.
4. Using the DELAY TIME MULTIPLIER, adjust the waveform such that the 10% point is intensified and record the dial reading.
5. Similarly, using the DELAY TIME MULTIPLIER adjust the 90% point so that it is intensified and record that dial reading as well.
   The pulse risetime (or falltime) is simply the difference between the two dial settings times the A SWEEP TIME/DIV control setting.

Using the formula
Risetime = (2nd dial reading − 1st dial reading) × Delayed sweep time (A SWEEP TIME/DIV setting)



[EXAMPLE]

For the example, the first dial reading is 1.20 (10% point) and the second is 7.38 (90% point) with the A SWEEP TIME/DIV set at 2μs.

Substituting the given value:

Risetime = (7.38 − 1.20) × 2 (μs) = 12.36μs

TIME DIFFERENCE MEASUREMENTS USING DELAYED SWEEP

Synchronized waveforms which are skewed in time can be accurately measured using the delayed sweep.

1. Apply the two signals to the CH1 and CH2 INPUTs, setting the V MODE to DUAL and selecting either ALT or CHOP display.
2. Set the SOURCE to the signal that is leading in phase and adjust VOLTS/DIV and SWEEP TIME/DIV for easy waveform observation.
   Set the A VAR control to CAL.
3. Set the B SOURCE switch to STARTS AFTER DELAY mode. Set the HORIZONTAL DISPLAY to A-INT-B and adjust the B SWEEP TIME/DIV and DELAY TIME MULTIPLIER to make the intensified portion coincide with the rising edge or falling edge of the waveform that is to be used as the reference.
4. Set the HORIZONTAL DISPLAY to ALT and use the ▲▼ TRACE SEP control to adjust the B sweep for easy observation.
5. Using the DELAY TIME MULTIPLIER adjust the pulse to any convenient vertical graduation line and record the dial reading at that point.
6. Using the DELAY TIME MULTIPLIER adjust the corresponding point on the second signal to the same vertical line and record the reading of the dial at this point as well. The time difference or skew of the two waveforms is then the second dial reading minus the first dial reading multiplied by the A SWEEP TIME/DIV control setting.

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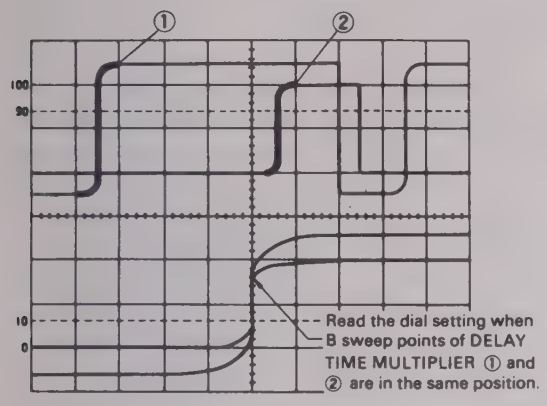
Using the formula:

Time difference = (2nd dial reading − 1st dial reading) × Delayed sweep time (A SWEEP TIME/DIV setting)



[EXAMPLE]

The reference signal dial reading is 1.00 while the second dial reading is 5.34 with an A SWEEP TIME/DIV setting of 2μs.

Substituting the value:

Time difference = $(5.34 - 1.00) \times 2(\mu s) = 8.68\ \mu s$

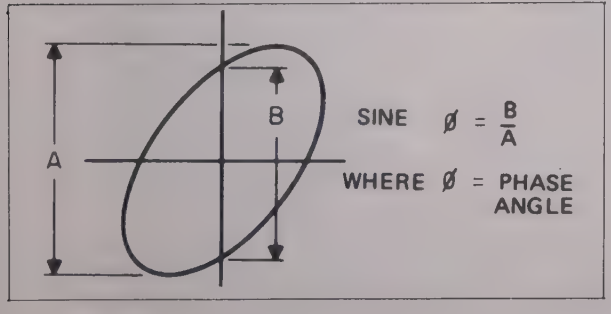
X-Y OPERATION

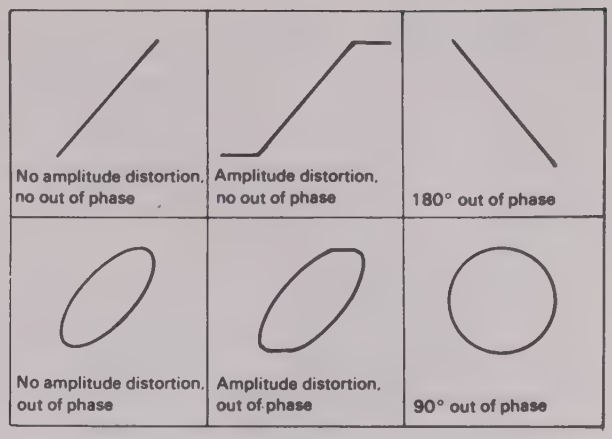
PHASE MEASUREMENT

Phase measurements may be made with X-Y operation. Typical applications are in circuits designed to produce a specific phase shift, and measurement of phase shift distortion in audio amplifiers or other audio networks. Distortion of amplitude is also displayed in the oscilloscope waveform.

To make phase measurements, use the following procedure

1. Using an audio signal generator with a pure sinusoidal signal, apply a sine wave test signal at the desired test frequency to the audio network being tested.
2. Set the signal generator output for the normal operating level of the cirucit being tested. If desired, the circuit's output may be observed on the oscilloscope. If the test circuit is overdriven, the sine wave display on the oscilloscope is clipped and the signal level must be reduced.



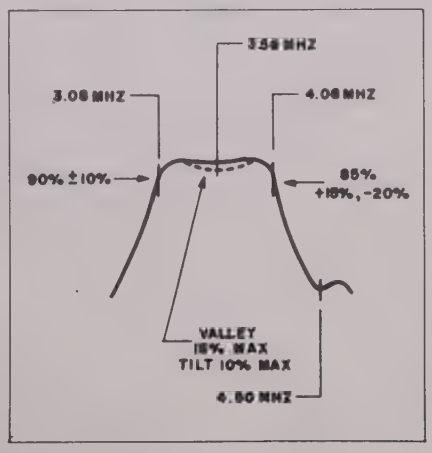

No amplitude distortion, no out of phase
Amplitude distortion, no out of phase
180° out of phase
No amplitude distortion, out of phase
Amplitude distortion, out of phase
90° out of phase

3. Connect the Channel 1 probe to the output of the test circuit.
4. Set the HORIZONTAL DISPLAY to X-Y.
5. Connect the Channel 2 INPUT probe to the input of the test circuit.
6. Adjust the Channel 1 and 2 gain controls for a suitable viewing size.
7. Some typical results are shown above. If the two signals are in phase, the lissajous' pettern is a straight diagonal line. If the vertical and horizontal gain are properly adjusted, this line is at a 45° angle.

A 90° phase shift produces a circuilar Lissajours' pattern. Phase shift of less (or more) than 90° produces an elliptical Lissajous' pattern. The amount of phase shift can be calculated from the oscilloscope trace as shown left below.

FREQUENCY RESPONSE MEASUREMENTS

1. Connect the RF or AF output of a sweep generator to the input of the circuit under test. Connect the output of the circuit under test to the CH1 INPUT; a demodulator probe will provide a standard frequency response curve, but a standard probe can be used which will result in an envelope display.
2. Connect the sweep voltage output of the sweep generator to the CH2 INPUT.
3. Set the HORIZONTAL DISPLAY to X-Y, and adjust the CH1 and CH2 controls for suitable viewing size.



APPLICATIONS

4-CHANNEL APPLICATIONS

The sensitivities of CH1 to CH4 are calibrated and each channel has 70 MHz band width. The trigger signals of CH3 and CH4 can be obtained from each preamplifier. This unit can be used not only for external synchronization but also for checking 4-Channel at a time.

Application

1. Checking logic signal timing
2. Monitoring video signals
3. Measuring audio signal gain and phase characteristics

The details of the logic signal timing checking are described below.

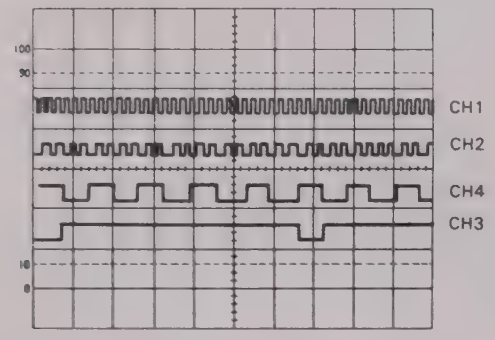
Logic signal timing indication

Control setting

V. MODE: QUAD, ALT A. SOURCE: EXT CH3

HORIZONTAL DISPLAY: A

To obtain stable synchronization, synchronize with the longest period channel (in this case, CH3).



In the above application, when the HORIZONTAL DISPLAY switch is set to ALT, the main and delay sweep waveforms are displayed on the CRT at a time. The portion in which the intensity is modulated is enlarged to enable easy checking.

Main and delay sweep waveforms (Magnified by 10 times)

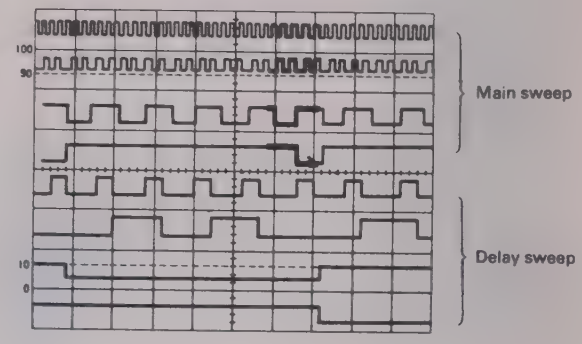
Control setting

V. MODE: QUAD, ALT

A. SOURCE: EXT CH3

HORIZONTAL DISPLAY: ALT

B. SOURCE: STARTS AFTER DELAY



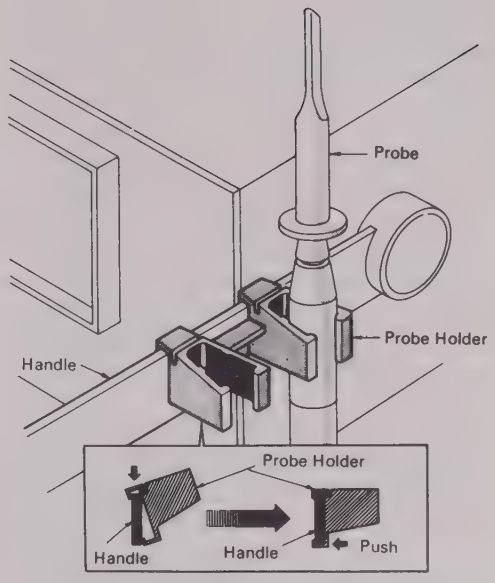
ACCESSORIES

PROBE HOLDER

The probe holder is attached to the handle as shown. Install the probe holder as follows:

1. Rest the upper two claws of the probe holder on the top surface of the handle (see inset).
2. Push lower claws toward handle to lock probe holder in place.
3. Probe can now be inserted into holder.

CAUTION:
When disengaging the probe holder from handle, disengage lower jaw first to prevent breakage.



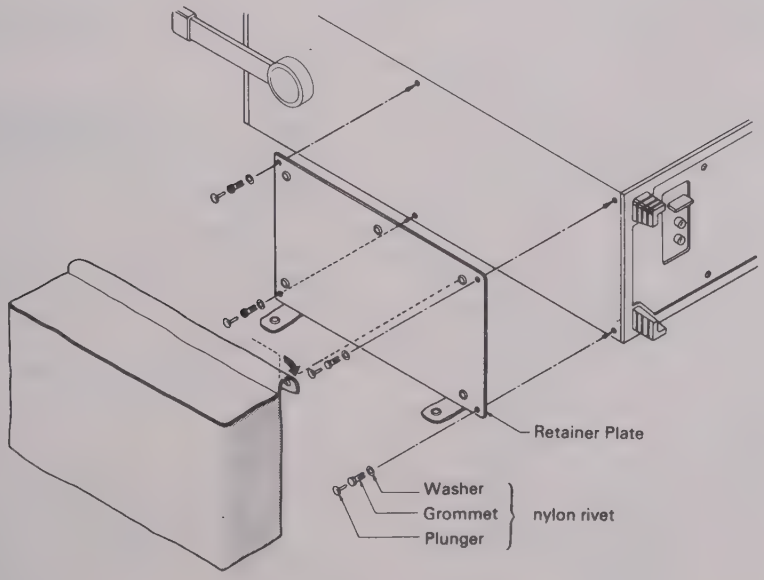
LC-100 FRONT PANEL PROTECTIVE COVER

This molded plastic cover snaps over the front panel for complete protection of the CRT and knobs when carrying and transporting the oscilloscope.

MODEL LC-150 PROBE POUCH

This soft vinyl pouch attaches to the right side of the oscilloscope housing and provides storage space for two probes and the instruction manual. Install the probe pouch as follows:

1. Unsnap the probe pouch from the retainer plate.
2. Align the retainer plate with the 4 holes on the right side of the case, with the 3 snaps at the top.
3. Attach the four corners of the retainer plate to the oscilloscope case with the four nylon rivets supplied.
4. Attach the probe pouch to the retainer plate using the snap fasteners.



ACCESSORIES

MODEL PR-40 10:1/DIRECT PROBE

The **B & K-Precision** Model PR-40 deluxe probe is designed for use with wideband oscilloscopes to 100 MHz. The PR-40 is a slim-body probe of precision lightweight construction. A three position switch selects 10:1 or direct modes, or a reference position that grounds the tip through a 9 megohm resistor.

Accessories included with the PR-40 are a spring-loaded retractable tip cover, insulating tip, BNC tip adapter, and IC tip. The insulating tip is designed for probing dense solidstate circuitry with little danger of shorting nearby components. The BNC adapter tip converts the probe tip into a push-on BNC fitting, ideal for interface with test points or output jacks. The IC tip guides the probe contact into any pin of a standard DIP, making it almost impossible to short two pins of an IC.

The PR-40 is supplied with both grey and red adhesive strips, which are particularly useful for instant identification of the channel to which a probe is connected. The PR-40 and accessories come in a convenient vinyl case.

MODEL PR-32 RF DEMODULATOR PROBE

This probe permits display and analysis of the modulation envelope of RF signals to 250 MHz (−6 dB @250 MHz). Input impedance is 30 kΩ minimum, shunted by 4.5 pF maximum. Internal shielding protects against stray RF pickup.

INSTRUMENT CONNECTING CABLES

The following **B & K-Precision** cables, which may be purchased separately, may be useful for connecting your oscilloscope directly to other equipment:

Model CC-41. 36" RG/58U with a BNC connector on each end.

Model CC-42. 36" RG/58U with a BNC connector and UHF connector (PL-259).

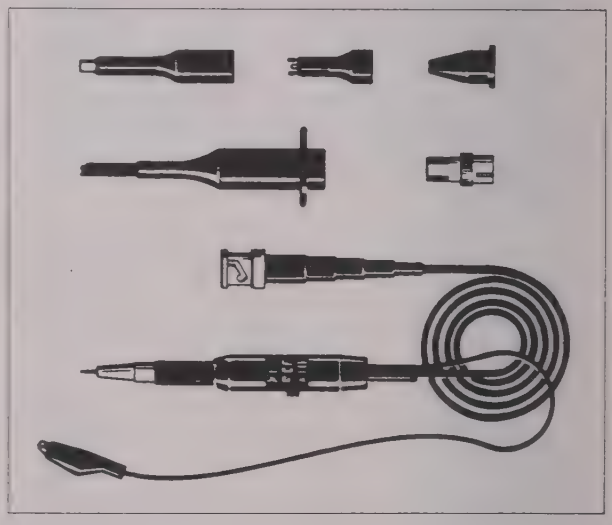
Model CC-43. 36" RG/58U with a BNC connector and banana plugs.

Model CC-44. 36" RG/58U connector and coaxial microphone connector.

Model CC-45. 36" RG/58U with BNC connector type N connector.

MODEL PR-37 DELUXE PROBE

The **B & K-Precision** Model PR-37 deluxe probe is designed for use with wideband oscilloscopes to 100 MHz. The PR-37 is a slim-body probe of precision lightweight construction. A three-position switch select 10:1 or direct modes, or a reference position that grounds the tip through a 9MΩ resistor. The 52" coaxial cable is extremely flexible. Accessories included with the PR-37 are a spring-loaded retractable tip cover, insulating tip BNC tip adapter, IC tip and an insulated compensation capacitor adjustment tool. The insulating tip is designed for probing dense solid-state circuitry with no danger of shorting nearby components. The BNC dapater tip converts the probe tip into a push-on BNC fitting, ideal for interface with test points or output jacks. The IC tip guides the probe contact into any pin of a standard DIP, making it almost impossible to short two pins of an IC. The PR-37 is available in both grey and red colors. Probes of different colors are particularly useful with a dual-trace scope for instant identification of the channel to which a probe is connected. The PR-37 and accessories come in convenient zippered vinyl case. Model PR-37G is grey and PR-37R is red.



MAINTENANCE

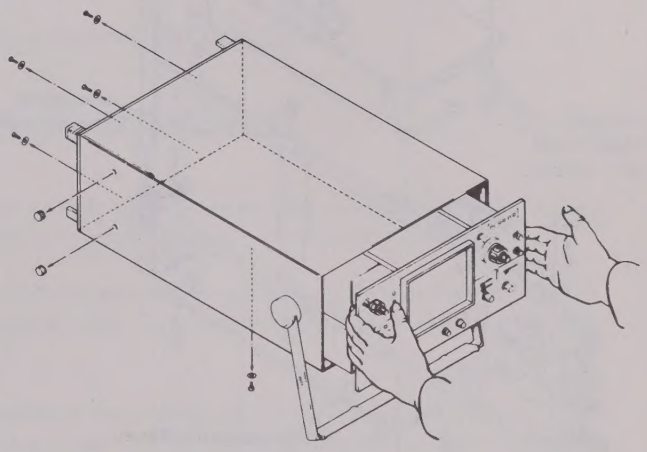
WARNING

The following instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.
A shock hazard is present when the housing is removed from the oscilloscope. High voltage up to 12,000 volts is present when the unit is operating, and high voltage may be retained for long periods after the unit is turned off. Unplug the oscilloscope and discharge high voltage capacitors before performing service procedures.

REMOVAL OF CASE

1. Pull out CH3 and CH4 POSITION knobs.
2. Remove the 4 screws located at the rear of the case and the 1 located at bottom with a ⊕ screwdriver. Carefully slide the body forward from the case.
3. To install the body in the case, place the case horizontally and slide the body into the case using the rails located at the bottom of the case. Then, place the body vertically and engage the case front edge into the front panel groove.
4. Temporarily insert the case retaining screws and then tighten them evenly.
5. Install the CH3 and CH4 POSITION knobs.

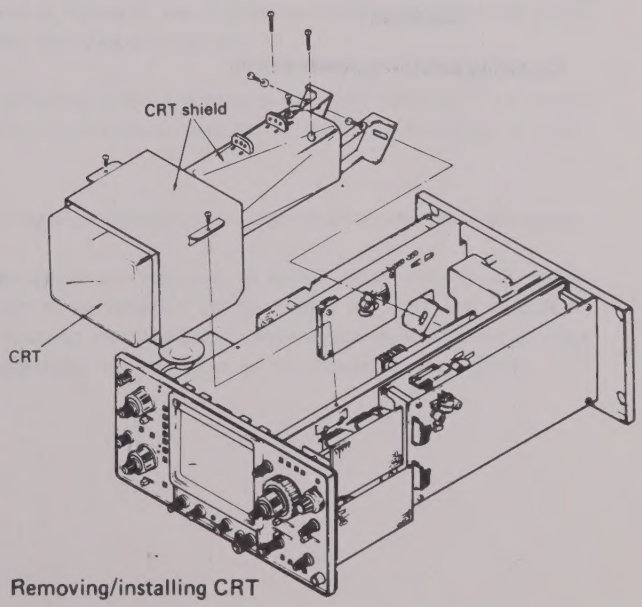
CAUTION:
A voltage of 12 kV is applied to the CRT socket and anode cap. Before removing the case, turn the power off and pull out the power plug. After removing the case, take care not to touch them.



REMOVING/INSTALLING CRT

1. When servicing CRT, do not loosen the CRT band. Only remove the CRT retaining screws, then slide the CRT backward and raise the socket. The CRT can be removed easily.
2. Insert the CRT from the socket side until the CRT comes in contact with the shield plate and tighten the CRT band retaining screws.
3. As slots are provided in the CRT bracket, the CRT can be moved right and left, and back and forth.
   As the bracket is inclined by 45°, the CRT can be positioned as required.

CAUTION:
High voltage may remain on the anode of the CRT long after power is removed. Before removing the CRT, connect the anode to the ground via a 100 kΩ load for 5 seconds to discharge the voltage.

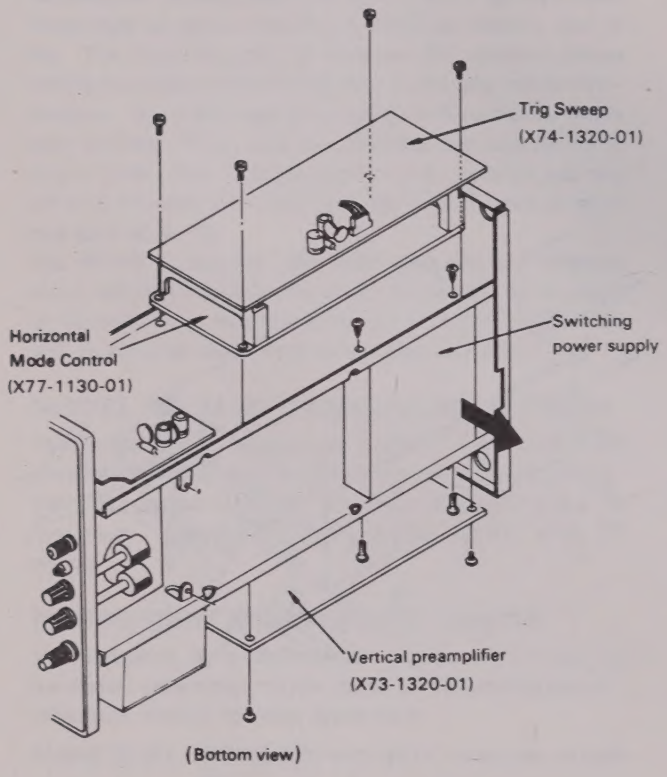


Removing/installing CRT

MAINTENANCE

REPLACING SWITCHING POWER SUPPLY

The switching power supply is housed in the shield case located at the rear. To remove the switching power supply, remove the horizontal mode control (right) and vertical preamplifier (left) for access to the mounting screws which secure the switching power supply to the frame.



Replacing switching power supply

INSTRUMENT REPAIR SERVICE

Because of the specialized skills and test equipment required for instrument repair and calibration, many customers prefer to rely upon **B & K-Precision** for this service, if it is ever needed. We maintain a network of **B & K-Precision** authorized service agencies of this purpose. To use this service, even if the scope is no longer under warranty, follow the instructions given in the WARRANTY SERVICE INSTRUCTIONS portion of this manual. There is a nominal charge for instruments out of warranty.

ADDITIONAL SERVICING INFORMATION

A complete service manual will soon be available for the Model 1570 Oscilloscope. Preparation was under way while this manual was being printed, and it is probably now available. Requests for the service manual, should be sent to the **B & K-Precision** Service Department address listed in the WARRANTY SERVICE INSTRUCTIONS. Be sure to specify Model 1570.

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the MAINTENANCE section of your **B & K-Precision** instruction manual for adjustments that may be applicable.
2. If the above-mentioned does not correct the problem you are experiencing with your unit, pack it securely (preferably in the original carton or doublepacked). Enclose a letter describing the problem and include your name and address. Deliver to, or ship PREPAID (UPS preferred in U.S.A.) to the nearest **B & K-Precision** authorized service agancy (see list enclosed with unit).

If your list of authorized **B & K-Precision** service agencies has been misplaced, contact your distributor for the name of your nearest service agency, or write to:

B & K-Precision, Dynascan Corporation
Factory Service Operations
4050 North Ravenswood Avenue
Chicago, Illinois 60613
Tel (312) 327-7270
Telex: 25-3475

Also use this address for technical inquiries and replacement parts orders.

LIMITED ONE-YEAR WARRANTY

DYNASCAN CORPORATION warrants to the original purchaser that its **B & K-Precision** product, and the component parts thereof, will be free from defects in workmanship and materials for a period of one year from the date of purchase.

DYNASCAN will, without charge, repair or replace, at its option, defective product or component parts upon delivery to an authorized **B & K-Precision** service contractor or the factory service department, accompanied by proof of the purchase date in the form of a sales receipt.

To obtain warranty coverage in the U.S.A., this product must be registered by completing and mailing the enclosed warranty registration card to DYNASCAN, **B & K-Precision,** 6460 West Cortland Street, Chicago, Illinois 60635 within fifteen (15) days from the date of purchase.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. It is void if the serial number is altered, defaced or removed.

DYNASCAN shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states or countries do not allow limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may also have other rights which vary from state to state or country to country.

For your convenience we suggest you contact your **B & K-Precision** distributor, who may be authorized to make repairs or can refer you to the nearest service contractor. If warranty service cannot be obtained locally, please send the unit to **B & K-Precision** Service Department, 4050 North Ravenswood Avenue, Chicago, Illinois 60613, properly packaged to avoid damage in shipment. Outside the U.S.A., please contact the Service Department for the name of the closest service center.

B+K PRECISION DYNASCAN CORPORATION

6460 West Cortland Street
Chicago, Illinois 60635

480-339-9-001B